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SURFACE-PLATES, OR PLANOMETERS, AND SCRAPED SURFACES.

By Joshua Rose.

There are many who believe that surfaces properly planed, are sufficiently true for all ordinary practical purposes; but if those persons were to apply a surface-plate to a well planed surface one foot square, or to a common connecting-rod key as it usually leaves the planer, they will be effectually cured of their fallacy. It is impossible to hold a piece of metal sufficiently firm that it can be cut by a machine-tool without springing it, and though there are many cases in which the amount of this spring is imperceptible, there are also many in which it is sufficiently great either to spoil the work or make it considerably out of true. All working flat surfaces should be surfaced with a surface-plate, whether they are got up with a file or with a scraper. Scrapers are not intended as tools to take off a quantity of metal, but only for the purpose of making the work very true, and being used in conjunction with a file to ease away the high spots, not because it is impossible with a file of even sweep and flat cross-surface to file true, but because it is a quicker and easier method of obtaining a flat surface, and one that is indispensable to fine work if the file has warped to a sensible degree in the hardening process. If, after a piece of work has been planed and the surface-plate has been applied, it is found that the surface is somewhat out of true, as is generally the case, it is better to file the work until the surface is true, which process will be quicker than scraping from the commencement.

It is useless to apply a scraper promiscuously over a surface for the purpose of making it appear smooth; for a surface can be got up, so far as smoothness is concerned, far better with a file and French emery-paper than it can be with a scraper. Fig. 1 presents such a surface.

Fig. 1.

The Freeland Tool Works (Thomas & Co.) is noted throughout the United States for the excellence of its scraped surface-plates. A pair of surface-plates on exhibition at 111 Liberty street, New-York, and a pair in the possession of the author made at the above works, and by that well-known mechanic Washington Shapter, are as fine specimens of true-scraped surfaces as can be found. The proper method of procedure in scraping a surface is to first go all over it, leaving the scraper-marks as shown in Fig. 2; and then rescrap-

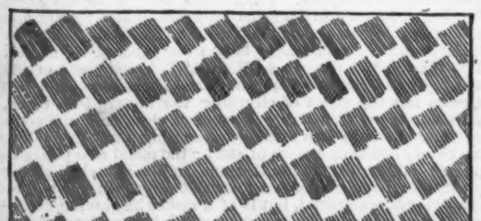


Fig. 2.

ing the entire surface, with the second scraper-marks at an angle to those left by the first operation, as shown in Fig. 3.

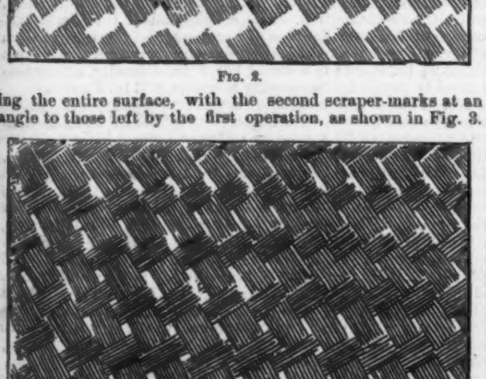


Fig. 3.

We must then apply the surface-plate as a test before proceeding with the scraping, first wiping the surfaces both of the work and the plate quite clean with old rags, which are better than new ones or waste. To show plainly where the surface-plate marks the work, we apply to the surface-plate a thin coating of red marking which is made by mixing dry Venetian red with ordinary lubricating oil, making a thick paint. With a piece of clean rag we apply the marking to the surface-plate, giving the face of the plate a barely perceptible coating, and rubbing the marking evenly all over with the palm of the hand. The plate may then be applied to the work, and moved backward, forward, and sideways over the work, or, if the work is small, it may be taken from the vise and rubbed upon the surface-plates, and the high spots upon the work will be shown very plainly by the marks left by the plate. The harder the plate bears upon the work the darker the marks will appear, so that the darkest parts should be scraped the heaviest.

After applying the plate, the scraper may again be applied, the marks being at an angle to the previous operation, the testing and marking by the plate and scraping process being continued until the job is complete, appearing as shown in Fig. 4.

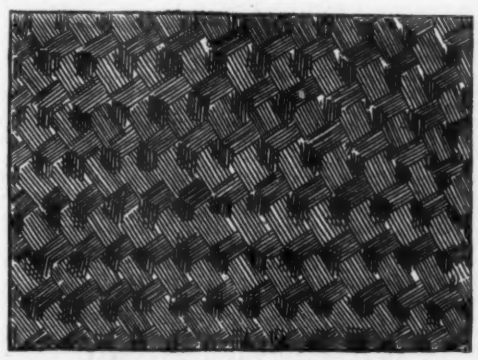
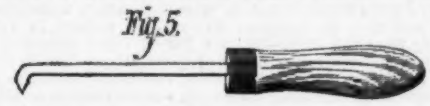


Fig. 4.

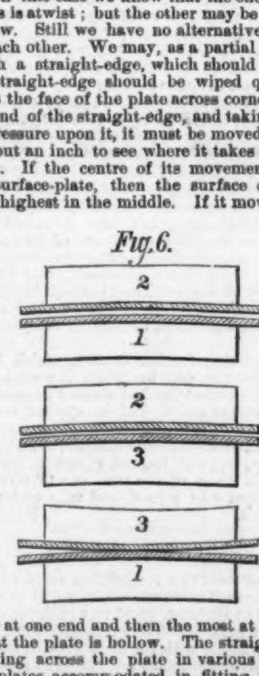
It will be noted that the scraper-marks are much smaller and finer at and during the last few scrapings; and it may be here remarked that the scrapings are very light during the last few finishing processes. The best form of scraper is that shown in Fig. 5, the edge being carefully oil-stoned, and the

Fig. 5.



cutting-edge being kept moist when it is used upon steel, wrought iron, or brass, which will make it cut smoother. The usual method adopted to obtain a true surface-plate is to plane up three plates which we will term Nos. 1, 2, and 3. Nos. 1 and 2 are first scraped to fit each other, and then No. 2 is fitted to No. 3. Now, it is obvious that in fitting No. 1 to No. 2 we have had nothing to guide us as to making either surface true. One plate may bear upon opposite corners only, while the other may bear upon all four corners, or all round the edges. In this case we know that the one bearing on opposite corners is atwist; but the other may be hollow, or both may be hollow. Still we have no alternative but to scrape them to fit each other. We may, as a partial guide, test both surfaces with a straight-edge, which should be used as follows: The straight-edge should be wiped quite clean, and placed across the face of the plate across corners, then taking hold of one end of the straight-edge, and taking care to place no vertical pressure upon it, it must be moved sideways back and forth about an inch to see where it takes a fulcrum from on the plate. If the centre of its movement is at the centre of the surface-plate, then the surface of the plate is rounding, or highest in the middle. If it moves on the plate

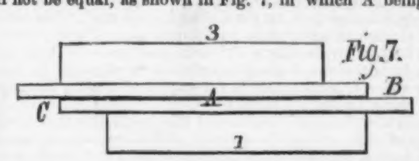
Fig. 6.



first the most at one end and then the most at the other end, it denotes that the plate is hollow. The straight-edge should be applied lying across the plate in various directions, and the two first plates accommodated, in fitting them together, by the indications of the straight-edge. Plates 1 and 2 having been fitted together, we take No. 3 and scrape it so that it fits No. 2, not operating upon No. 2 at all, the operation being continued until No. 3 is a fair fit to No. 2.

We next take No. 3 and try it with No. 1. Now, supposing 3 and 1, when tried together, show each other to be rounding, it is proof that No. 1 is rounding to half the amount of difference between it and No. 3, as shown in Fig. 6. From which it will be perceived that the two nearest together faces of 1 and 2 may fit together, 1 being rounded, the other hollow. Number 2 may then be taken as a gauge whereby to fit No. 3, their surfaces being made to fit perfectly. But if we then take Nos. 1 and 3 and try them together, they will disagree to twice the amount that No. 1 was out; that is to say, twice the amount that No. 1 varied from being a flat surface.

We next rescrape No. 1 to half the amount, as near as we can judge, of the difference between it and No. 3, and having done so we rescrape No. 1 to No. 2, and No. 2 again to No. 3, and then recorrect No. 1 from No. 3 to half the amount of difference between them, continuing the whole operation until all three plates fit each other perfectly interchanged, when the job will be as perfect as it can be performed with three plates. Here, however, we may note as follows: The three plates being of the same length and breadth, and it being necessary to rub the face of one upon the other in order to show, by the marks, where they touch together, the abrasion of one face against the other, and therefore the marks, will not be equal, as shown in Fig. 7, in which A being the



faces of the plates moved one over the other so that they will mark each other, that portion of plate 1 denoted by B, and that part of plate 3 denoted by C are not in contact, and are not, therefore, being marked by contact, whereas the whole surface of the two plates save and except at and near the edges are in contact, and are, therefore, marking each other during the whole time of the duration of the movements. The consequence is that those parts of the surfaces which overlap each other mark themselves more lightly in proportion to the amount of their bearing than the rest of the surfaces, and since it is the lightness and heaviness of the marks which determine how much the part of contact must be eased by the scraper, it is evident that a surface-plate can not be made true to the highest practical attainable degree unless, having finished the three plates, we introduce a fourth whose size shall be sufficiently smaller that it can be rubbed back and forth upon the plate by which it is surfaced without overlapping at all.

A NEW STREET IN LONDON.

The new thoroughfare from Charing Cross to the Embankment, which has for some months past been in course of construction on the site of Northumberland House and grounds and adjoining property, is now fast approaching completion, and is intended to be opened for public traffic during the first week in April. Its length from Charing Cross to the Embankment approach is 1000 feet, the width of the carriage-way is 60 feet, and of the footpaths on each side, 15 feet, making the entire width of the street 90 feet, whilst the extreme width of the approaches at Charing Cross and the Embankment, respectively, are 160 feet. A tunnel or subway, 12 feet in width, and 8 feet in height to the crown of the arch, runs under the centre of the street from one end to the other. On either side of this subway, other smaller subways, in connection with it, diverge right and left in the direction of the footpaths, which rest on vaults, these vaults and side subways connecting the basements of the houses to be built on either side of the street with the main central subway. A shaft at the embankment end of the street leads down to the floor of the subway, admitting of laying down the gas and water main pipes, and connecting them by service-pipes, along the side subways, with the houses on each side of the street. This arrangement renders altogether unnecessary the breaking up of the surface of the street at any future period for laying down new gas or water pipes. It also applies to the drainage and sewerage of the street, the main sewer being carried under the central subway, and connected by the side subways with the house-drains. From the embankment end the street is already nearly completed to the extent of about three parts of its entire length. The level of the roadway is about four feet over the crown of the tunnel, and above a layer of concrete wood pavement will be laid down. At the embankment end this final portion of the work has been going forward during the present week, and is already completed to the extent of about 300 feet in length. The pavement is being executed by the American Wood Pavement Company. With the exception of the short unfinished portion at the Charing Cross end, the flagging of the footpaths is also completed; and the avenue of trees intended to extend the entire length of the street, on each side, is in course of being planted, at a distance of 40 feet apart. The trees are furnished by Mr. Weston, and Mr. Sinclair superintends the planting. The gas-mains are already laid down in the subway, so far as it is completed, and we learn that the water company will commence laying down their pipes next week. The new street will admit of access to the Embankment from Craven street by an inclined footpath.

The new street was planned by Sir Joseph W. Bazalgette and Mr. Vulliamy, and Messrs. Mowlem, Burt & Freeman are the contractors.

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NATURAL EUTHANASIA.

By B. W. RICHARDSON, M.D., F.R.S.

BY the strict law of Nature, a man should die as unconscious of his death as of his birth.

Subjected at birth to what would be, in the after-conscious state, an ordeal to which the most cruel of deaths were not possibly more severe, he sleeps through the process, and only upon the subsequent awakening feels the impressions, painful or pleasant, of the world into which he is delivered. In this instance the perfect law is fulfilled, because the carrying of it out is retained by Nature herself: human free-will and the caprice that springs from it have no influence.

By the hand of Nature, death were equally a painless portion. The cycle of life completed, the living being sleeps into death when Nature has her way.

This purely painless process, this descent by oblivious trance into oblivion, this natural physical death, is the true euthanasia; and it is the duty of those we call physicians to secure for man such good health as shall bear him in activity and happiness onward in his course to this goal. For euthanasia, though it be open to every one born of every race, is not to be had by any save through obedience to those laws which it is the mission of the physician to learn, to teach, and to enforce. Euthanasia is the sequel of health, the happy death engrafted on the perfect life.

When the physician has taught the world how this benign process of Nature may be secured, and the world has accepted the lesson, death itself will be practically banished; it will be divested equally of fear, of sorrow, of suffering. It will come as a sleep.

If you ask what proof there is of the possibility of such a consummation, I point to our knowledge of the natural phenomena of one form of dissolution revealed to us even now in perfect, though exceptional, illustration. We have all seen Nature, in rare instances, vindicating herself despite the social opposition to her, and showing how tenderly, how soothingly, how like a mother with her foot on the cradle, she would, if she were permitted, rock us all gently out of the world; how, if the free-will with which she has armed us were brought into accord with her designs, she would give us the riches, the beauties, the wonders of the universe for our portion so long as we could receive and enjoy them; and at last would gently withdraw us from them, sense by sense, with such imperception that the pain of the withdrawal would be unfelt and indeed unknown.

Ten times in my own observation I remember witnessing, with attentive mind, these phenomena of natural euthanasia. Without pain, anger, or sorrow, the intellectual faculties of the fated man lose their brightness. Ambition ceases or sinks into desire for repose. Ideas of time, of space, of duty, lingeringly pass away. To sleep and not to dream is the pressing, and, step by step, still pressing need; until at length it whiles away nearly all the hours. The awakenings are short and shorter; painless, careless, happy awakenings to the hum of a busy world, to the merry sounds of children at play, to the sounds of voices offering aid; to the effort of talking on simple topics and recalling events that have dwelt longest on the memory; and then again the overpowering sleep. Thus on and on, until, at length, the intellectual nature is lost, the instinctive and merely animal functions, now no longer required to sustain the higher faculties, in their turn succumb and fall into the inertia.

This is death by Nature, and when mankind has learned the truth, when the time shall come—as come it will—that "there shall be no more an infant of days, nor an old man who hath not filled his days," this act of death, now, as a rule, so dreaded because so premature, shall, arriving only at its appointed hour, suggest no terror, inflict no agony.

The sharpness of death removed from those who die, the poignancy of grief would be almost equally removed from those who survive, were natural euthanasia the prevailing fact. Our sensibilities are governed by the observance of natural law and the breach of it. It is only when Nature is vehemently interrupted that we either wonder or weep. Thus the old Greeks, fathers of true mirth, who looked on prolonged grief as an offence, and attached the word madness to melancholy, even they were so far imbued with sorrow when the child or youth died, that they bore the lifeless body to the pyre in the break of the morning, lest the sun should behold so sad a sight as the young dead; while we, who court rather than seek to dismiss melancholy, who find poetry and piety in melancholic reverie, and who indulge too often in what, after a time, becomes the luxury of woe, experience a gradation of suffering as we witness the work of death. For the loss of the child and the youth we mourn in the perfect purity of sorrow; for the loss of the man in his activity, we feel grief mingled with selfish regret that so much that was useful has ceased to be. In the loss of the aged, in their days of second childishness and mere oblivion, we sympathize for something that has passed away, and for a moment recall events saddening to the memory; but how soon this consoling thought succeeds and conquers—that the race of the life that has gone was run, and that for its own sake the dispensation of its removal was most merciful and most wise!

To the rule of natural death there are a few exceptions. Unswerving in her great purposes for the universal good, Nature has imposed on the world of life her storms, earthquakes, lightnings, and all those sublime manifestations of her supreme power which, in the infant days of the universe, cowed the boldest and implanted in the human heart fears and superstitions which in hereditary progression have passed down even to the present generations. Thus she has exposed us all to accidents of premature death, but, with infinite wisdom, and as if to tell us that her design is to provide for these inevitable calamities, she has given a preponderance of number at birth to those of her children who by reason of masculine strength and courage shall have most frequently to face her elements of destruction. Further, she has provided that death by her, by accidental collision with herself, shall, from its very velocity, be freed of pain. For pain is a product of time. To experience pain the impression producing it must be transmitted from the injured part of the living body to the conscious centre, must be received at the conscious centre, and must be recognized by the mind as a reception; the last act being in truth the conscious act. In the great majority of deaths from natural accidents, there is not sufficient time for the accomplishment of these progressive steps by which the consciousness is reached. The unconsciousness of existence is the first and last fact inflicted upon the stricken organism: the destruction is so mighty that the sense of it is not revealed.

The duration of time intended by Nature to extend between the birth of the individual and his natural euthanasia is undetermined, except in an approximative degree. From the first, the steady, stealthy attraction of the earth is ever telling upon the living body. Some force liberated from the body during life enables it, by self-controlled resistence, to overcome its own weight. For a given part of its cycle the force produced is so efficient that the body grows as well as moves by its agency against weight; but this special stage is limited to an extreme, say of thirty years. There is, then, another period, limited probably also to thirty years, during which the living structure in its full development maintains its resistance to its weight. Finally, there comes a time when this resistance begins to fail, so that the earth, which never for a moment loses her grasp, commences and continues to prevail, and after a struggle extended from twenty to thirty years, conquers, bringing the exhausted organism, which has daily approached nearer and nearer to her dead self, into her dead bosom.

Why the excess of power developed during growth or ascent of life should be limited as to time; why the power that maintains the developed body on the level plain should be limited as to time; why the power should decline so that the earth should be allowed to prevail and bring descent of life, are problems as yet unsolved. We call the force that resists the earth vital. We say it resists death, we speak of it as stronger in the young than in the old; but we know nothing more of it really, from a physical point of view, than that while it exists it opposes terrestrial weight sufficiently to enable the body to move with freedom on the surface of the earth.

These facts we accept as ultimate facts. To say that the animal is at birth endowed with some reserved force, something over and above what it obtains from food and air, would seem a reasonable conclusion; but we have no proofs that it is true, save that the young resist better than the old. We must, therefore, rest content with our knowledge in its simple form, gathering from it the lesson that death, a part of the scheme of life, is ordained upon a natural term of life, is beneficently planned, "is rounded with a sleep."

AWARDS AT THE CENTENNIAL.

TO THE EDITOR OF THE SCIENTIFIC AMERICAN:

Mr. R. H. Buel, in his suggestion; (published in a late SUPPLEMENT, No. 13), for standard tables wherewith to compare and judge the relative merits of mechanical and other devices exhibited at expositions, seems to me to overlook one very important fact, namely, that all inventions are not necessarily mere improvements on prior conceptions. To be sure it is rare that an invention Minerva-like springs in full panoply from the brain—and the Patent Office adopts this theory, it appears, in the caption of specifications—but, on the other hand, entirely new capabilities, new combinations, new adaptations are constantly appearing, and to prepare a table which, though it might hold good for to-day or for ten days, would be equally correct for a month or a year, would, to judge by the weekly lists of patents granted for "new and useful" ideas in this country *alone*, be practically impossible. To gauge this plan by the success of the English cattle-raisers is not just. All the attributes of a cow, for example, are determined by nature. By careful artificial selection, by scrupulous attention to food and other circumstances embraced under the single term "enveronment," these attributes may be exaggerated (or more properly developed) or repressed. But no man can impart to the animal a single capability which is not already in potential existence. Either every capability of the brute is known, or else, if it be obscure and only adduced by development, then the progress of the latter is so slow as amply to afford time for its comprehension, and so to allow of comparison between its stages.

Now, if all machines developed, and did so within the limit of certain capabilities, then a parity of reasoning might be urged. But supposing two machines reached an identical result in entirely different ways—in both only a minority of "points" corresponding, others widely differing—how then could a standard table apply? Again, suppose one machine combines (like some wood-working apparatus) a multiplicity of attributes; another machine, belonging to a like class, has some of the capabilities of the first, besides others of its own; another machine, by like means, does something altogether different. Each stands practically alone. Unless a table be constructed showing that sawing has such and such an importance, planing another, boring another, and so on—a clear impossibility. I fail to see where a standard of relative comparison could be found.

Without suggesting further details, which I think any thoughtful person can call to mind, it seems that to machines for a single pupose, and of similar general design, Mr. Buel's standard tables could well be applied, but to suggest their applicability to the whole range of mechanical invention is to reach the obvious *reductio ad absurdum*, that the same runs only in constant and limited channels, and that all the future mechanical ideas of the race can by some prescience on the part of experts be crystallized into and provided for in tabulated forms.

PARK BENJAMIN.

PRESERVED TIMBER.

SOME trunks of trees in a remarkable state of preservation have recently been found in the wash-dirt in the Race-Course Company's mine at Haddon, Victoria, at a depth of a little over 200 feet from the surface. The grain and color of the wood corresponds very much with the blackwood of the present day, and seemed to have suffered so little from its repose for countless ages in its damp and dark bed as to be scarcely distinguishable from the wood of trees cut down within the last year or two.

[Mining and Scientific Press.]

AN IRON FURNACE FOR CALIFORNIA.

AT last California is to have her first iron furnace. This, which is usually the first manufacturing enterprise of a new country where the material is found, seems to be almost the last to have started here. The reason of this is doubtless the greater attraction which the precious metals have had for the capital and energy of the State. The enterprise of Mr. P. Fitzhugh, an experienced iron master, has at length drawn attention to this source of wealth, and capital necessary to insure the completion of the works during the coming summer has been secured. The furnace will be built near Clipper Gap, on the line of the Central Pacific railroad, where a fine quality of magnetic iron ore is found in great abundance, and where also all other materials needed in the manufacture of charcoal pig-iron are easily and cheaply accessible.

There is up to this time no iron furnace west of the Rocky mountains—except one in Oregon—and all of our iron is consequently imported. Mr. Fitzhugh thinks that he has found a place that far exceeds any in the United States for making pig, bloomed, and rolled iron of the best quality at the least cost anywhere known to him, and with cheaper transportation to market than any other iron beds in Calfornia.

The cost of making one ton of pig-iron at the locality named is computed at $20, as follows: Mining and delivering two tons of ore, to make one ton of iron, $3; mining and delivering limestone (which costs the Portland, Oregon, furnace $5), 25 cents; superintending and labor, $3.75; charcoal, 125 bushels at 10 cents (many furnaces only take about 100 bushels, and it is delivered to the Oregon furnace for nine cents), $12.50; repairs on furnace making about 5000 tons, $2500 per year (or per ton) 50 cents; total, $20 per ton. The transportation from furnace to San Francisco is $3.66 per ton, so the cost of working and delivering one ton of pig-iron in this city is estimated as above at $23.66.

According to analysis by Professor Price, of this city, this magnetic iron ore contains 62.44 per cent of iron, and has no injurious ingredients that would in any way affect the quality of iron. The iron ore and limestone beds are large, rise nearly to the surface, and can be quarried and delivered much cheaper than the cost to New-York or Oregon furnaces, and the latter have to drift many feet under ground and transport their ores or limestone hundreds of miles. The ores are in the vicinity of an immense growth of wood, which can be easily and cheaply conveyed to the proposed furnace, and can be reduced to charcoal at any season of the year, and do not require to be collected in large quantities for winter supplies. It is stated that the ores will work the toughest iron, suitable for car wheels and steel rails. Professor Whitney, late State Geologist of California, in Vol. I., page 884 of his report, gives an account of the deposits of iron ore within six miles of Auburn, Placer County (the place in question), and says:

"It is in larger quantity than has yet been discovered in the auriferous slate series, cropping out on a side hill and forming a mass of more than thirty feet thick, of which the longitudinal extent is not known, although it is evidently considerable. It is hematite, appears to be of excellent quality and remarkably pure and free from intermixture with rocks. This locality is more favorably situated than any yet discovered in the State."

We understand that the amount of capital required in the business of starting this furnace for the first year is about $75,000, and that all the arrangements have been perfected. We are very glad to know that at last California is to have an iron furnace, and hope it will not long be the only one. The population of the State has increased so materially, and the demand for iron for various purposes is so great, that it is a pity to see so much money going out of California which could be saved within its borders and at the same time develop a new and profitable industry, both for capitalists and laboring men.

[Engineer.]

A NEW ALLOY.

THE White Brass Company, of Southwark, are about to introduce a new metal to the public which possesses some interesting peculiarities. Tests made with it in the Royal Gun Factories have given some very remarkable results, and we do not think an apology is necessary for laying some particulars concerning this alloy before our readers. This new alloy is termed "Manganese Bronze," it is composed of any ordinary bronze alloy combined with manganese, which it appears has the effect of cleansing the metal of all oxide, and rendering it very homogeneous and close grained, even a good sized ingot broken through presenting a fracture as fine and close grained as a piece of steel; the metal also possesses increased strength, toughness, and hardness, which latter quality can be increased very considerably. In color it resembles good gun-metal, but is of a rather brighter and more golden hue. It can be forged at a red heat and rolled into rods or sheets and drawn into wire and tubes.

Six specimens were submitted by the White Brass Company for trial and tested by the permission of Colonel Younghusband at the Royal Gun Factories for tensile strength, elastic limit, and ultimate elongation. These consisted of three cast specimens of different degrees of hardness, and three from each of these forged at a red heat and drawn down from a cast ingot about 2¼ in. square to a round bar 1 in. diameter, afterwards turned to gauge for the testing machine .533 in. diameter.

No. 1 cast—intended for construction purposes where strength and toughness are necessary—gave an ultimate tensile strength of 24.3 tons per square inch, with an elastic limit of 14 tons and an elongation of 8.75 per cent. No. 1A, forged from the same metal as No. 1 was cast from, gave a tensile strength of 29 tons per square inch, elastic limit 12.6 tons, elongation 31.8 per cent. No. 2 cast—rather harder than No. 1—tensile strength 22·1 tons, elastic limit 14 tons, elongation 5.5 per cent. No. 2A, forged from the same, tensile strength 28.8 tons, elastic limit 13.2 tons, elongation 35.35 per cent. No. 3 cast—still harder—tensile strength 28.6 tons, elastic limit 16.8 tons, elongation 3.8 per cent. There was a slight flaw in this specimen, which caused it to break with a less strain, and to stretch less than it would otherwise have done. No. 3A, forged from No. 3, tensile strength 30.3 tons, elastic limit 12 tons, elongation 20.75 per cent.

It will be seen from the above that No. 1 cast specimen is about equal in tensile strength and elongation to wrought-iron of average good quality, while its elastic limit is rather higher, for scarcely any wrought-iron will exceed ten or eleven tons, and all the forged specimens considerably exceed the very best wrought-iron, both in tensile strength and ultimate elongation, and are fully equal to mild qualities of steel. We believe it will be admitted that if such results can be obtained, and certainly secured, the results of these experiments prove this new manganese bronze to possess very valuable qualities, and such as will render it useful

for a variety of purposes for which gun-metal and yellow metal are now employed.

When simply cast, even the tough qualities are harder than gun-metal, possess about double its strength up to the elastic limit, and about fifty per cent more ultimate strength, while at the same time it will bear more bending and hammering, and the harder qualities intended to be used when pressure and friction come into play are considerably harder than gun-metal. The forged specimens are about twice the ultimate strength of gun-metal and forged yellow metal now generally used for bolts, etc.

The details of the process of manufacturing this metal are, for obvious reasons, not yet made public by the White Brass Company. There is every reason to believe, however, that there is nothing occult about the process of manufacture, and that manganese bronze may be regarded as a commercial article. Of course use is the great test, and we can not say whether, in practice, metal as excellent as the specimens tried at Woolwich can always be secured. Be this as it may, however, the commercial manufacture of manganese bronze makes a step in the science and art in metallurgy of no small importance.

RESISTANCE OF METALS.

IN a paper read before the American Society of Engineers, Prof. R. H. Thurston states that the results of his observation may be briefly summarized as follows:

In iron, an elevation of the elastic limit very generally occurs under stress, to a marked degree. It is very variable in maximum amount, and in the time required to produce it. Some metals exhibit it to an almost imperceptible extent after long exposure to strain; other irons experience a great increase in their power of resistance to stress within the new elastic limit, and its development may sometimes be the result of but a very brief period of exposure to the action of that molecular rearrangement which seems to be the cause of this phenomenon. The maximum increase noted by the writer is about 30 per cent, and the time required for its development has sometimes not exceeded a half minute; in other cases, the elevation of the elastic limit has been scarcely perceptible after several days.

In steel, the same variation in the amount and in the time needed for its development has been noticed.

In the various other metals and in the alloys, this action has not been found to occur in any case where the material was inelastic; on the contrary, it has been found that inelastic metals—particularly tin and metallic alloys of similar mechanical properties—have, when exposed to constant stresses exceeding their so-called elastic limits, gradually and continuously yielded by a process of flow which, in some instances, was observed to proceed uninterruptedly for days together, and would apparently have continued until fracture ensued, could the experiment have been carried to that extent.

These experiments have led the writer to suppose, as intimated in the paper referred to, that the force of cohesion and that force which gives stability of form to solids and distinguishes them from liquids—a force called by Prof. Henry "polarity"—are quite distinct modes of molecular action. Some materials—as the stronger of the ductile metals—exhibit great cohesion, and yet may flow under the action of a constant force, as in the cases last referred to above; while others—for example, over-hardened steel—may have great polarity, and consequently great stability of form, while exhibiting a relatively low power of cohesion.

It is in metals which belong to the latter class, rather than in those of the former character, that the elevation of the elastic limit by strain is observed. The explanation already proposed, that this apparent increase of resisting power is really a consequence of the relief of internal stresses due to methods of manufacture, or to circumstances which have, by external application of force, prevented such a molecular arrangement of particles as would naturally take place, still seems to the writer the most satisfactory explanation. The close relation of this action to that observed by Prof. Johnson, thirty years ago, and illustrated by the process termed by him "thermo-tension," has been pointed out on a former occasion.

During the two years which have elapsed since the first announcement of the phenomenon of the elevation of the elastic limit by strain, a large mass of valuable data has been accumulated, which may at some future time be collated. In no case, in the whole range of these researches, has any indication been observed of a reduction of resisting power during the distortion of metal, between—on the one hand—the passing of the elastic limit, and—on the other hand—the point at which incipient rupture commences.

CONCLUSIONS.—The writer is therefore led to conclude that the simple extension or straining of any member of any metallic structure is not a cause of weakness, except where it produces an actual reduction of section resisting rupture, or where it brings the line of stress into a new direction in which it acts either with a larger component of force in the former direction of stress, or, as in the case of a re-flexure of the metal, it takes the material at disadvantage strategetically, after a new disposition of its particles has taken place.

The conclusion seems also proper, that the elevation of the elastic limit by strain can only occur in metals which are elastic, and are capable of being placed in a condition of reduced resisting power by internal stress, by artificial or external force.

Finally, the conclusion has been arrived at, that structures are not weakened by stresses exceeding the elastic resisting power of their members, whatever the material of which they are composed, and even when made of metals having no elasticity and capable of yielding, like tin, by flow, unless such strains as are produced are productive of actual molecular disruption.

[National Car-Builder.]

TURNED CAST-IRON CHILLED WHEELS.

IT will be recollected that at the October monthly meeting of car-builders, Mr. W. W. Lobdell, of the Lobdell Car-Wheel Works of Wilmington, Del., gave an account of some experiments he was then making to test the practicability of turning off the chilled tread of cast-iron wheels in order to remove surface defects and secure a true circular periphery, the method being similar to that employed upon chilled rolls for paper-mills. The first experiment was upon a pair of 26-inch hollow spoke engine-truck wheels that had been in service nearly eleven months, and had run not less than 22,000 miles. They were then removed on account of blotches or scabs, one of which was at least 2¼ inches in diameter and about ⅛ of an inch deep. Mr. Lobdell was of the impression that if these defects could be turned out and the wheels made perfectly circular, they would not only wear free from such defects, but would thereafter give a greatly increased mileage over ordinary wheels. The wheels were accordingly turned off by means of a special tool of peculiar temper and hardness, and placed, in connection with a pair of steel-tired wheels, under a heavy engine running on the Philadelphia, Baltimore and Wilmington road. On the 31st of January, inclusive, they had run 22,330 miles since the turning, and upon being examined on the 8th of February, they were found to be perfectly smooth, the wear being less than 1-16 of an inch, with no appearance of blotches or other defects, and apparently good for many thousand miles yet. The pair of steel-tired wheels had in the mean time been taken out and re-turned, and are now quite as much worn as the chilled wheels.

We are informed by Mr. Lobdell that a pair of 30-inch double-plate tender wheels that had been running about a year, and had developed a number of blotches, have been turned in the same manner, and placed under the tender of a heavy passenger-engine on the same road. The train was a fast accommodation, making 22 stops in 28 miles, and equipped with air-brake. On 31st January, inclusive, they had run 18,242 miles, and were apparently in as good condition as when they started. This pair of wheels, and the 26-inch ones above referred to, have been in service long enough to develop any defects of this kind, if any such existed in them since the turning. Mr. Hodgman, the master mechanic of the P. W. & B. road, was so impressed with the merits of the turned wheels, that he had four new 30-inch hollow-spoked ones turned and put under a new 17×24 cylinder engine which runs the Limited Express over this division of the New-York and Washington route, and at a high rate of speed. A set of 26-inch truck-wheels has also been furnished to the North Pennsylvania road; a pair of 28-inch tender to the Philadelphia and Baltimore Central; and also quite recently some 33-inch double-plate passenger-wheels to the P. W. & B., all with turned treads, but none of them have been running long enough to warrant any conclusions from the mileage already made.

In view of the importance of an increase in the general average of wheel mileage, and of some method by which wheels can be made perfectly round, these experiments are entitled to the earnest attention of railroad men. The practical utility of Mr. Lobdell's plan has not yet been sufficiently demonstrated, perhaps, to warrant any reliable estimate of the percentage of increase in mileage, and the economy in other respects of turned wheels as compared with the ordinary kind; but it seems to us that all railroad managers who are at all progressive in their views, should lose no time in testing the matter to their own satisfaction. This can very easily be done by placing, say a set of four 33-inch turned wheels under a car with four ordinary ones, and allowing such car to make as long and continuous trips as practicable. The tests that have already been applied, although on a limited scale, render it quite certain that, for engine and tender service, the use of wheels with a turned chilled tread will be attended with the most economical results, by giving a mileage approximating to what is claimed for the best steel wheels. Nearly all the turned wheels that have yet been tried are of small diameter, and in heavy engine service making short runs, requiring considerable time to make a large mileage.

The Lobdell Car-Wheel Company is now constructing a lathe specially adapted for the turning of chilled wheels, either on or off the axle, and when it is completed the company expect to be able to furnish such wheels at a price so little above that of the ordinary ones as to make it an object for railroads to use them. The advantages claimed are a uniform diameter; freedom from blotches and chill defects; less liability to slip, slide, or break; steadiness of motion; absence of fanning or jarring; and greatly increased mileage—in fact, all the advantages of the steel wheel with very much less cost.

OBSERVATIONS ON ANTS.

LINNEAN SOCIETY, LONDON, FEB. 17.

J. GWYN JEFFREYS, Esq., Vice-President, in the Chair. Sir John Lubbock, Bart., read a highly interesting and suggestive paper, "Additional Observations on Ants," basing this on a further series of experiments in order to ascertain the relative amount of intelligence or otherwise displayed by the habits of these insects. Fastening a nest of them to a pole, and causing them in their peregrinations to traverse a board from which two paper bridges led in devious routes, like the inverted letter Y (⅄), the prongs of which were movable, one containing larvæ, the other not, he ascertained that they reached the former rather haphazard than otherwise, many wandering to the empty spot without obvious intelligent cause. By slightly varying the apparatus and ingeniously testing the acuteness and what share in their relations might be due to the senses of sight, smell, and hearing, he arrives at the conclusion that in the last (audition) they are sadly deficient; but that smell, possibly even more than sight, guides in many of their supposed intelligent acts. As regards their affection, and interest in each other's welfare, he throws doubts; a few good, bad, and many indifferent ants appearing to exist, as in human society. His recent observations, on the whole, substantiate his former deductions as to the predominance of a kind of instinct, rather than a complex system of intelligent communication superior to that of other social animals.

Dr. Cobbold made some remarks, and exhibited the new human fluke, *Distoma sinense*, discovered by Professor McConnell, of Calcutta, showing its organization could not be confounded with other known species. Prof. Leuckhart's *D. spatulatum* is a synonym of the foregoing; and Prof. Leidy's supposed specimens, obtained by Dr. Kerr, of Canton, belong rather to *D. crassum*, lately discovered by Prof. Busk.—Dr. John Anderson read a communication "On the Cloacal Bladders, and on the Peritoneal Canals in Chelonia;" these he shows both exist and are absent in various Asiatic genera. He considers the sacs have relation to the mode of life; and as to the canals, regards them as accessory to transpiration, and not functionally connected with generation: they appear to answer to the abdominal pore in some sharks and Ganoid fishes.

A NEW FABRIC—FEATHER CLOTH.

By LECOMTE, LEFERVE, and ANDUZE, of France.

Useful for wearing apparel of all kinds, ladies' cloaks, etc.—The inventors claim to having succeeded in manufacturing a fur from wool, which is afterwards coated with feathers—preferably those of water-birds—and then re-covered with a woollen fur. At this stage the fabric is ready for carding.

The manipulations may be epitomized as follows: The first operation is the sorting of the feathers, in which care must be taken to exclude the quills and the nerves, inasmuch as the down of the feather can alone be utilized. This sorting may be done by machinery, by placing the feathers in a sort of fan, and subjecting them to a current, causing the down to be carried forward, whilst the heavier portions of the feathers fall to the ground by their own weight. Washing is the second operation. The down is dipped in water saturated with the so-called Marseilles soap of Payen, is next put into a square box or press, where it is partly dried by pressing. Since by this latter operation the down becomes quite compressed, it is passed again through the fan, partly to be opened out, and partly for further drying it, so that it may only retain from 25 per cent to 30 per cent of the soap-water.

The mass thus prepared is now greased with 25 per cent of oil or oilen, and is then allowed to pass three times through the fan. As woollen fur is next prepared on the ordinary carding engine, and covered with feather, of about four times its weight; the latter are re-covered by another woollen fur, and the whole is then passed through the carding engines. Cards of No. 26 or 28 are recommended for the job, and care must be taken in preventing the feathers from falling off.

Self-actors are not to be used for spinning the fabric, but handspinning is preferable. The weaving may be done in the usual manner, although generaly speaking a worsted warp will be found most advantageous; on the other hand, the warp will vary according to the fabric to be finished. Of course the size of the shuttle used will depend on the thickness of the thread.

The fabric is dressed by first oiling and then fulling, care being taken to dry after fulling—after which the stuffs are hung up loose.

Lastly, for dyeing purposes a large vat should be used, so that the piece may remain in its full breadth. The piece is next placed on one of Pasquier's machines, then hung up loose, and subsequently beaten with sticks and brushed to remove superfluous feathers A gloss may be imparted to the fabric by steaming it.

DESTRUCTION OF VEGETABLE MATTERS IN WOOL.

A REPORT has been made to the Paris Academy of Sciences on this important subject by MM. Barral and Salvetat.

The economy in using Australian and South-American wools alone shows the importance of such an inquiry. The mechanical methods formerly used have been almost entirely abandoned, partly on account of their costliness. By the use of chemical agents the vegetable matters adhering to wool are pretty well destroyed, even in the case of cloth and other woven fabrics.

The practical fundamental principle of this chemical action is the treatment of the tissue by means of a solution of sulphuric acid (4° to 5° by Baumé's areometer) and the passing of the former afterwards through a stove heated to 125° to 140° C. This plan was patented by M. Frizon. Another manufacturer, M. Joly, proposed to replace the sulphuric acid by hydrochlorate of alumina, and the experiment succeeded; but the stove requires to be raised to a rather higher temperature. M. Chevreul, the Solon of French chemists, showed that in the experiment in question the hydrochlorate of alumina acted by its own special qualities, and not by setting free hydrochloric acid by means of heat.

The authors of the communication have made numerous experiments to determine the behavior of cellulose and ligneous matter, as well as wools, in the presence of a great number of chemical agents. The main facts are given as follows:

1. That cellulose and ligneous matter become disorganized under the action of the following chemical agents, provided that the tissue dried in the centrifugal machine after inhibition be at once placed in a stove at a temperature of 140°: Sulphuric acid, hydrochlorate of alumina, hydrochloric acid, nitric acid; the chlorides of zinc, iron, tin, and alumina; the bisulphate of potash, chrome alum, boric acid, acid phosphate of lime, and oxalic acid.

2. That wool, on the contrary, is not attacked under the foregoing conditions.

3. Other agents which are mentioned below do not destroy vegetable fibres under the same conditions: Chlorides of sodium, potassium, barium, calcium, magnesium, and mercury; the hydrochlorate of ammonia, nitrates of ammonia, mercury, lead, soda, barytes, lime, and potash; sulphate of copper, ammonia, manganese, iron, lime, magnesia, soda, and potash; bisulphate of potash, ammoniacal alum, nitrate of alumina, alum of potash, tartrate of soda, and of potash; the phosphates of ammonia, soda, and potash; iodide of potassium, chlorate of potash, hydrochlorite of potash (known in France as eau de Javelle, and used and abused by the laundresses there); oxalate of ammonia and of potash; tartaric, acetic, and nitric acids.

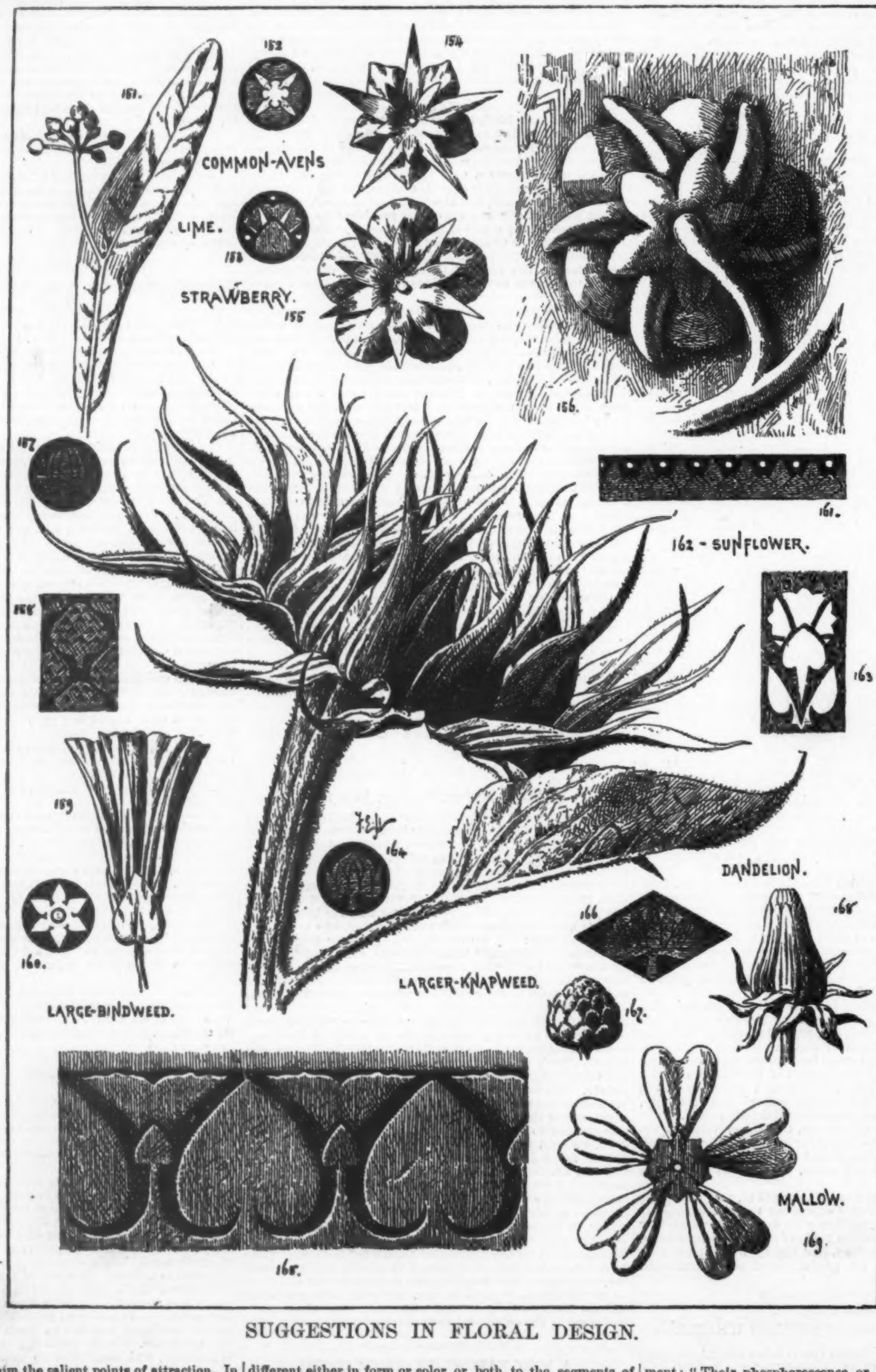
4. That the first effect produced by the agents which have the property of destroying vegetable matter under the conditions laid down above, is to take away a portion of the water contained in the vegetable matter, and to carbonize it.

OXYGEN AND OZONE.

THE *British Medical Journal* remarks that though it is popularly known that after a thunder-storm milk turns, beef-tea and other soups get sour, and meat of all kinds becomes tainted and unfit for food, yet the immediate cause of these phenomena has not been satisfactorily explained. M. A. Boillot, who is well known for his researches for the properties of ozone, has lately communicated to the French Academy of Sciences certain observations which are of interest. During last summer M. Boillet tried some experiments with a bit of fresh beef, weighing 100 grammes, which he divided into two equal portions. One of these was put into a glass-stoppered bottle containing air, and the other into another glass-stoppered bottle containing ozonated air (five milligrammes to a litre). The size of each bottle was 200 cubic *centimètres*. Both were placed in a cellar where the temperature was about 59° F. Five days after this the meat in the first bottle was in a state of putrefaction; the other piece remained unaltered, and was as fresh as on the day it was put into the bottle. On the tenth day it was still unaltered in appearance, and there was no unpleasant smell whatever about it; but the bottle having been opened only for a few seconds, although it was immediately closed, the meat in it was in a state of putrefaction the following day, which M. Boillet attributed to the ingress of air when he opened the bottle. The same experiment was performed with milk but the air contained in the first bottle was replaced by oxygen. The results were exactly the same; the milk was found to be in a perfect state of preservation in the ozonated air, whereas it had completely turned in the bottle containing oxygen. These experiments offer many suggestions of great interest, and M. Boillet hopes, by further experiments in the same direction, to determine the kind of action which ozone exercises over animal matter, and thus be able to explain the effect produced by thunder-storms on alimentary substances, the importance of which can hardly be overrated.

SUGGESTIONS IN FLORAL DESIGN

THOUGH both the botanist and the ornamentist should agree in one point—a real love of nature—the two approach the study of plants from different stand-points—since, while minute and, in fact, microscopic differences of form and internal structure possess great value to the systematic botanist, such features have little or no value to the designer; and, while the botanist sees in the central reproductive organs of the blossom its chief cause and function, and regards the corolla as mainly a protection to the more needful and valuable organs, the designer's idea of a flower is the reverse of this, and the gayly-colored petals and the green cup or calyx in which they rest are to him the salient points of attraction. In our present series of sketches we naturally approach the subject from the ornamentist's point of view. In a review of one of our books a critic expressed his astonishment at the use of the word "ornamentist." It is, however, a sufficiently expressive and useful term, and we have met with it too frequently in the writings of others to be able to delude ourselves that to us really belongs the credit, as our critic implies, of introducing it for the first time into our language. Bracteal forms supply us with another illustration, since, though interesting physiologically to the botanist, they are but subordinate features, while the designer will find them often of great value. They are the little leaf-like forms that may often be found near a head of flowers, and they are generally sufficiently distinct in form from the true leaves of the plants to make their identification a matter of no difficulty. The bract of the lime is shown in Fig. 151, and the heart-shaped form at the base of the bindweed, Fig. 159, is another example. We have introduced it in Fig. 165, a design based on that plant. Heads of composite flowers, like the sunflower, Fig. 162; the knapweed, Fig. 167; or the dandelion, Fig. 168, are surrounded externally by bracts, and they may also be very well seen in the mallow, Fig. 160, where the five-pointed calyx has as appendage an outer ring of three bracts. In the strawberry and avena, Figs. 154, 155, the calyx is composed of five parts, the smaller alternating parts external to these being bracteal—a feature very well shown in Fig. 156, a piece of fourteenth-century Gothic. The bracteal forms are often different either in form or color, or both, to the segments of the calyx—a point illustrated in Figs. 159, 160, 161. Fig. 157 is suggested by Fig. 168, and Fig. 158 by the scale-like arrangement of bracts protecting the flower-head, Fig. 167, of the larger knapweed.—F. EDWARD HULME, F.L.S., F.S.A.—*Building News.*



SUGGESTIONS IN FLORAL DESIGN.

THE LANTERN-FLY OF SALVADOR.

THAT curious insect, the Lantern-Fly, *Fulgora*, an inhabitant of Central America, was first brought particularly into notice by Madame Merian, who found it in Guayana, and asserted that it had the power of emitting light. This statement, we think, has been assumed to be true without subjecting the species to further examination. One of her stories, that there are to be found in Guayana spiders that catch small birds in their nets and prey upon them, is even more doubtful than the light of the lantern-fly. A walk through the woods around Panama will discover spiders' nets spread from tree to tree about as strong as silk thread. It is the custom of humming-birds to visit spiders' webs in the morning just as they visit the opening flowers in search of insects, and so they may easily get entangled, as happened to our knowledge in one instance in Taboga. With respect to the lantern-fly, and that it takes its name because the Indians of Guayana carry those insects with them to light their way through the woods at night, would be interesting—if true. In a note at the foot of the article in the Salvador paper occurs this statement: "Their phosphorescence or luminous property is no longer doubtful." Yet the writer who described and named the insect does not say he actually saw those insects emitting light from their bodies. But assuming this to be so, he founds on this belief a very pretty theory, that the luminiferous property may probably be a prerogative of the male insect, adding, that it was said the Indians, when they had to travel in the dark, fixed the male insect to one leg and the female to the other. In the island of Taboga, in the month of June, a year or two ago, a pair of these insects was found on a Coratu tree covered with a cottony envelope. They were kept alive some days, but showed no symptoms of luminiferous properties. If the contrary has been proved in Central America, a new fact would be established in natural history.—*Panama Star.*

[Journal of the Franklin Institute.]

PSEUDO PERSPECTIVE DRAWINGS FOR ILLUSTRATION OF MECHANICAL OBJECTS.

By ROBERT BRIGGS.

A MERE drawing from an artist's *vue d'œil* is *such* a verisimilitude as will be tolerated by no practical man. A photograph, as ordinarily taken with a short focus (and often cat-a-cornered), which can (if printed as a single card view) be reduced to perspective by holding to the eye, at some exact plane distance, may, from necessity, serve its purpose when isolated and examined alone. Such photographs, or engravings made from them, are very unsatisfactory for book illustration, not only from non-conformity of the plane distance with the proper book-reading one, but from the unsuitability of the plane distances with each other, together with dissimilarity of vanishing points and differences of angle of view. Many of the objections here stated attend pictures not made by the camera.

These considerations are sufficiently familiar to the intelligent engraver, and need only statement to him, but there are many other persons, more or less accustomed to books and pictures, who can not have appreciated the bearing of these remarks upon the general illustrations daily observed by them. It is perhaps not saying too much, when the assertion is made that most engravings are *not* seen or looked at as pictures in perspective, and that many people never see a picture as a scene, or endeavor to do so. Their eyes have become accommodated to a conventional representation, as really in false perspective as a Chinese drawing appears to be. Education has merely accustomed them to an arbitrary system of lines in which distance is imagined by reduction of size, and a picture *seems* to be correct, regardless of the ratio of the reduction. The Chinese perspective without reduction only fails in comparison to a miniature picture with an excessive angle of vision by the admission of the existence of one correct point of view for the latter, although this point of view sometimes is chosen at less than eight inches from the eye.

To see a picture properly, the plane of the picture which is looked at *must* be at right angles to the line from the eye to the vanishing-point, and the eye must be exactly so far removed from the picture as to give the real effect of relief and distance.

The angle of vision of a lens is much greater than that of the eye, and although some advantage is afforded in taking pictures by a camera, especially interior or street views, whereby the larger part of a room or an entire facade can be depicted on one plate, it must not be overlooked that such views are purely arbitrary, and from no possible point of sight can they be correct. This defect of the lens becomes painfully apparent when a photograph of a large machine erected in a small room is assayed, and it is (so far as our eyes are accustomed to picture) aggravated when the object is so large that the camera has, so to speak, to look up at it.

The *civilized* perspective is the transcript of intercepted rays on a *vertical* plane, and the deviation of the plane from the vertical, which occurs when the negative plate is deviated, although in strict accordance with the perspective, and although if the place of the eye viewing the plate is made relatively that of the camera which took the picture, the visual difficulty disappears; yet the error of deviation of view condemns such a picture altogether.

These facts in perspective can be readily seen by examination of a set of photographs from nature, and can be made conspicuous to an audience by a lantern.

For the purpose of mechanical illustration it is requisite that the details should be not merely sketched vaguely, but distinctly shown with draughtsmen's or photographic accuracy. No background or distance is desired, and the object should be isolated. Most objects have a front which it is desirable to exhibit. When some one front will not suffice to show all that is wished, two or more views looking at the machine at the sides or ends are called for.

The direct plane views fail to give any relief to projecting parts, even if deep shadows are thrown down, and it follows, consequently, that the object should be taken at a slight angle with the line of front. This angle had best not be excessive; the front should predominate, and the retreating end should only give depth and projection to the outline.

Heavy sunlight shadows should not be made in any case; the lines of shadows are confusing. Shades should be distinct, but subdued and dark lining is necessary for effect. The distant (or back) objects or lines should never be shaded or obscured, nor should the distance itself be shaded back, but the lines be lighter—*more distinct*—ending in the more remote parts in pure outline, unshaded and fine-lined. It is to be noticed that there being no background, the distance should die into the white of the paper.

These remarks apply as well to engravings with correct perspective as to those drawn as hereafter described, and the system of line drawing applies equally to mechanical and architectural drawings. Elevation, Plan, Section, etc.

In *drawings* great effect and clearness is imparted by using black ink and broad dark lines for the front parts, clear black lines, but thinner and less pronounced, for the parts behind, omitting all dark lining on outlines further back, and by using very faint ink (still getting perfect lines) for objects behind the machine, or for distant walls. [For exhibition to the public shaded architectural drawings are admissible, but for practical work in architecture and mechanics a shade or shadow on a drawing is an evidence of idleness, if not incompetency.]

As a general rule, the objects to be depicted should be twisted to an angle of 9° to 10° (that is, the person or camera viewing them should stand so that a given *depth* of side will appear on the perspective plane about one sixth as long as the same dimension on the front view), and photographs or sketches from objects thus *posed*, if taken from long distances, so that the angle of vision for the entire figure shall be small, can be used singly or in groups on a page with much satisfaction.

If a group of articles of similar character are to be shown, it is very much better that the same point of view shall be taken for them so that the comparison, each with the other, can the more readily and positively be made.

This consideration leads away from a true perspective at once, and points to a mere projection. And it will be found that a plane projection at the angle designated will differ so little from a true perspective for miniature views, as generally looked at, as to deceive any but a critical observer. In such projections it will be found advisable to consider the plane of vision above the object in the same position as was assumed at the side of it.

The kind of isometrical drawing thus obtained differs from that usually practised by the reduction of the proportion of side and top dimensions to those of the face, but the result of this reduction is to remove much of the obvious distorted effect. The system can not be recommended either for large objects or for large views, and should be confined to miniature representations. Still in miniature representations of objects of considerable magnitude it can be adopted with success.

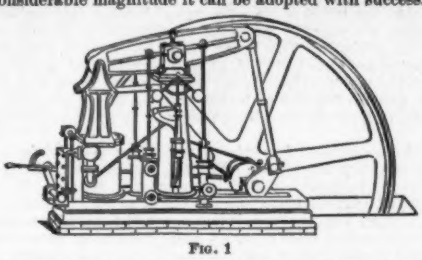


FIG. 1

Figure 1 shows an outline sketch of an engine-machine directly from a working drawing to scale. This sketch is such as is required by the engraver on the block of wood before engraving and shading.

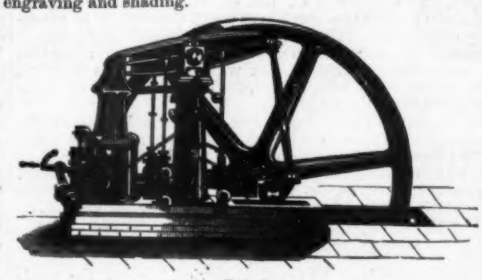


FIG. 2.

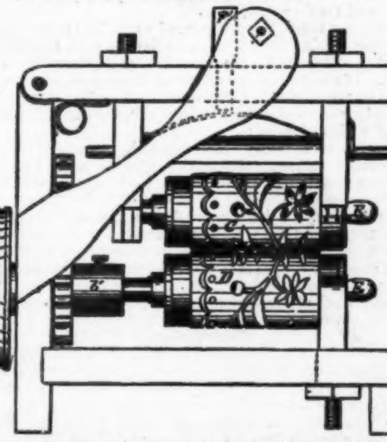
Figure 2 shows a finished wood-cut from the same sketch, and can be pronounced satisfactory from either the pictorial or mechanical stand-point.

The sketch Fig. 1 was made in less than $2\frac{1}{4}$ hours' time from a working drawing, which showed a front elevation, two end views, and a plan, all drawn to the scale of $1\frac{1}{2}$ inches to the foot, or one eighth full size. The front dimensions were all taken by a pair of proportional compasses, set at one to six, and the end and top dimensions by reducing one to six *twice over*. The scale of the figure is consequently one-forty-eighth on the front and one two-hundred-and-eigthy-eighth at the end and top. Of course all the lines in horizontal planes at right angles to the front (in the machine itself or its working drawing) are inclined 45° to the horizontal or vertical lines in the face of the Fig. 1, and any length measured on those diagonal lines is a little more than *one fourth* he front scale (the true scale of end or top dimensions consequently becomes one two-hundred-and-fourth part in place of one two-hundred-and-eighty-eighth.)

The example chosen to illustrate here is purposely that of a large object, the natural size being over 8 feet high by 15 feet long. If the style of drawing suffices for such a picture, and without painful distortion, and the scale is practically preserved, it is apparent that for smaller objects its suitability is demonstrated.

EMBOSSING-MACHINES FOR WEARING-APPAREL.

By J. STEINLEIN, Egg Harbor City, N. J.



THE cylinders, which form the principal part of my invention, are constructed of any suitable metal, and made hollow to receive heated rollers E E, the same being provided at their ends with knobs *i*, to facilitate handling in withdrawing or placing them in the cylinders.

The figures upon the cylinders C are raised, while those upon the lower roller D are sunk, so that the two together will form a rotary die, and the fabric, as it is fed along between the cylinders, will be ornamented with raised figures upon its surface.

[For the Scientific American Supplement.]

SPIRIT PHOTOGRAPHY.

So many inquiries have been made by persons evidently seeking truth regarding the possibilities or probabilities of spirit photography, that I am tempted to contribute some of the results of my own experience in such researches for general information to those whose interest or occupation deny them practical investigation of the subject. The leisure of several years' practice of the photographic art I have devoted to independent photographic investigation, with considerable success, and it is natural that I should have felt much interest in any thing so conspicuous as the claims of spirit photography.

In the pursuit of these investigations, I constructed a room capable of being made perfectly dark, into which variously qualified lights were admitted, usually through the medium of a large condensing lens which concentrated all the entering light to a fine point, where it was disintegrated and then spread out to fill the room with light of any desired character. Among other experiments performed, was that of making photographic likenesses in this room while perfectly dark, or at least so dark to the human eye as to render all objects invisible, the person sitting not perceiving just when his portrait was taken, though directly facing the camera.

I thus satisfied myself that invisible beings could have their portraits photographed. Theoretically this same belief is universal among optical scientists, and based upon knowledge of the actinic properties of the invisible rays of the solar spectrum; but, so far as I can learn, I am the first to practically demonstrate the feasibility of invisible portraiture. Putting this with the fact that visible objects, material or immaterial, can have their likenesses taken if posed before the sensitive plate in the camera, within range and focal distance, leaves spirit photography inferentially possible under suitable conditions, but still undemonstrated. Extended efforts to furnish suitable "conditions" according to the best spiritualistic authority have failed to afford me any actual proof of spirit photography. I say "actual proof," because such *proof* can only be obtained by the artist himself, as I am convinced by many experiments that no one except the artist engaged can detect the many methods by which such *apparent* results can be obtained. Spirit pictures are usually exhibited as *prima-facie* evidence of their own genuineness, which is obviously absurd, and it is my intention here to explain several methods, partly original and partly already known, by which such apparent results may be obtained, the *results* being scarcely *prima-facie* evidence of genuineness, though otherwise satisfactory.

As regards the "artistic" *quality* of the pictures often offered as evidence, all of the many that I have seen are a disgrace to the noble art whose title should be "Recorder of the Sciences." As authentic likenesses they would not endanger a criminal if exhibited in a spiritual rogues' gallery, to assist in identification, and, while claiming significance as photographic art productions, they outrage every law of perspective and *chiaroscuro*. It will be remembered by both critics and sensitive people that in making this statement I am merely exercising my just right as an artist regarding the things I have seen, and that I am constantly desirous of enlarging my opportunities for observation of any thing pertaining to my art.

The most fruitful field for observation of queer appearances is the photographic apprenticeship. The chemical ignorance and incompetency of the beginner result in streaks, stains, blotches, and clouds, many of which have suggested resemblances to the human figure, and all of which ghosts are laid by the master's touch, because he has learned their simple cause and remedy. Dirty plates are very common causes, and the slightest finger-mark on the surface of a chemically clean plate makes a "dirty plate" of it. Under this head come the cases occurring where once-used plates are used over again after cleaning off the original picture. Such plates after cleaning exhibit no signs of being "second-hand" until chemically developed, when the original picture is liable under some conditions to show itself anew, either in whole or in part. Such plates are bought and sold among photographers, and needy artists oftentimes use their plates over and over again. The mention of these facts will sufficiently indicate the possibility that an artist may sometimes innocently impose upon himself or his patrons.

When the artist has motives for deception, a host of methods offer their various advantages. The simplest consists in soiling the plate by marking any invisible design upon its clean surface with the finger, or otherwise, which invisible design appears upon development of the plate. Another method consists in the selection of glass of soft quality, treating it with strong solutions to dissolve its surface and "honeycomb" its interior with microscopic crevices, and then making any desirable picture upon it. The picture may be finished and then rubbed off the glass so as to defy the closest scrutiny. But when a new picture is made upon the plate the old one inevitably reappears, usually fainter. A modification of this method is equally applicable to ferrotypes.

If actually clean plates are used, fraud may be practised by suitably placing transparencies of any desirable figures either in the camera box or plate holder, the image being developed with that of the person actually sitting. A lens and picture microscopically small may be so placed in the camera and still serve its purpose and escape detection. A minute *pin-hole* in the camera front serves as such a lens to picture *any* object at *any* distance in front of it about the room. Also the usual exposure of a really clean plate may be made and the desirable figure then added by holding the negative against another negative or transparency while exposed for a moment close to the lamp often used to light the dark room.

Another method possible of practice is that of confederacy, where the personating assistant steps for a moment behind the sitter and is thus faintly imaged. A "medium" may also obtain the portrait of his double by sitting before the camera half a minute, then rising and standing beside his former position for a few seconds—the developed plate revealing his double standing beside himself. A variation of this trick may be played without the sitter's knowledge by the artist moving the camera slightly just before the exposure is concluded, when the head and shoulders of the sitter are faintly outlined behind the distinct image.

Various substances capable of reflecting only the invisible or violet-colored rays of sunlight may be used to paint an invisible picture on the background behind the sitter, which becomes apparent upon development of the exposed plate.

I will mention here a method which I believe I am the first to announce. A magic lantern illuminated by condensed sunshine, like the solar microscope, or by burning magnesium, the electric or the lime light, or any other affording chemical rays, casts the image of any one or more desired objects on the background, but before leaving the lantern the rays of light are rendered practically invisible in daylight by passing them through the same medium used when "making portraits in the dark," this medium being capable of absorbing the illuminating rays but permitting the invisible chemical rays to be projected on the background or the sitter through an orifice practically unobservable, and only recognizable by the eye of the camera and its sensitive plate. The entire apparatus used need not be so large as a common brick, and is capable of exhibiting, without possibility of detection, any thing put into it,—the developed plate being the first proof of its existence. Operators familiar with the marvellous powers and capacities of the modern magic lantern will at once appreciate this revelation. I am not actually aware that this method is practised, but I know that this and other methods are perfectly practicable, and that *only the artist can know* if he practises them.

Experiments satisfy me that there is another method superior to all these, but I omit description of it here because to any other than myself it might seem equally as preposterous as spirit photography, and I do not wish to cast doubt upon my previous statements by additional ones that I will not willingly demonstrate;—so I pass on to photographic printing. In this field, by a skilled operator, almost any desirable effect can be obtained through the modern system of retouching, masking, and double printing, and if the distinct images, apparent in all I have seen are the only ones demanded,

the likeness may be identified by any trusting person who is bound to feel convinced. By such methods as these can be furnished by wholesale the floods of so-called spirit photographs forwarded in our mails in response to letters containing the customary fee.

After these revelations it may be inquired if I consider the question of the possibility or impossibility of spirit photography decided. Not by any means. I only give this information for the benefit of those who have not got it, that it may assist them to a better understanding of the subject,—that the believing spiritualist may know that there are means adequate to produce such *apparent* pictures, and that the scoffing skeptic may check his sneers by the discovery that invisible objects can reveal themselves in the camera,—in fact, *I have no hesitation in asserting that the beings or objects which we see posed before the camera are not the originators of the photographic image, but only visible accompaniments of the comparatively invisible surfaces which reflect the invisible rays of chemical light!*

The facts of spiritualism may prove spirit photography, but such apparent productions do not prove spiritualism. My own position is that of an unprejudiced investigator who has discovered enough to make him cautious as to assertions, while seeking to know more for science's sake. I am inspired by no faith, but by desire for knowledge; I seek conviction, not conversion, and in this position I offer no technical testimony in response to the clamors of spiritualists that science should investigate its assumed phenomena and declare upon its merits. In pursuance of this investigation I will afford every reasonable facility for demonstration of spirit photography, even to photographic instruction of those who otherwise consider themselves qualified for success but lack opportunity.

CARL MYERS.

MOHAWK, N. Y.

[Chemical News.]

THEORY OF THE PRODUCTION OF ANILINE BLACK BY MEANS OF THE SALTS OF VANADIUM.

By M. A. GUYARD (HUGO TAMM).

SINCE the interesting discovery of M. Pinkney is known it may be permissible to say a few words on the question of the formation of aniline black, hitherto obscure, but which the reaction of the salts of vanadium completely elucidates.

If we introduce into a normal mixture for aniline black, made up of water 100 grms., hydrochlorate of aniline, 8 grms., chlorate of potash or soda 3.5 to 4 grs., about 1 centigrm. of vanadous chloride or vanadate of ammonia, we see with surprise the liquor darken in a few moments, and then gradually deposit an abundant precipitate of aniline black. After about forty-eight hours the reaction is nearly complete, and the liquor is taken up in a thick paste, almost solid, in consequence of the formation of almost all the aniline black which it is able to furnish. This reaction is so delicate that 1 part of vanadous chloride transforms 1000 parts of hydrochlorate of aniline into aniline black, and that in practice 500 parts may thus be advantageously transformed by 1 part either of the chloride or of the vanadate of ammonia. This important discovery renders dyeing with aniline black as easy as printing, and nothing can equal the beauty of the blacks thus obtained. Since the discoveries of Lightfoot and Lauth there is no reaction which is calculated so much to generalize the use of aniline black both in dyeing and printing.

But this reaction is chiefly interesting in a chemical point of view. It is one of the most elegant reactions of chemistry. The author thinks he may give its true image by saying that the vanadium is a *fluid* spark which determines the combustion of the fluid mass of salts of aniline and of chlorate. We make aniline black by means of a drop of a salt of vanadium, just as we set fire to fuel by means of a match. The power of the vanadium salts in the production of aniline black is more than a thousand times greater than that of copper. The reason of this is intelligible if we know the properties of vanadium. There is no metal which passes more readily from the lowest to the highest stage of oxidation and returns again to the lowest. Under the feeblest reducing influences vanadic oxide becomes vanadous oxide, and under the faintest oxidizing influences vanadous oxide is re-converted into the vanadic. This is the whole secret of the power of vanadium—a power so great that the author thought at first he had encountered a new force, or at least one of those mysterious agencies named catalytic; but a closer study of the phenomenon soon led to its explanation. In fact, on dissolving vanadic acid in hydrochloric acid it is transformed into vanadous chloride, and on evaporating the latter in the air it is partly transformed into vanadic acid. On the other hand, if vanadous chloride and chlorate of potassa are brought in contact, the latter is decomposed with disengagement of chlorine, and the vanadous oxide is transformed into vanadic oxide. Reciprocally, if we introduce vanadic oxide, or an alkaline vanadate, into hydrochlorate of aniline, the vanadous oxide is instantly reduced to the state of vanadous oxide or chloride. If we introduce into a mixture of an aniline salt and of a chlorate 1–1000th of vanadous chloride or of a vanadate, aniline black is produced with the same energy. In fact, in the twofold contact with the oxidizing salt and the reducing organic compound, the vanadium passes with the speed of an electric spark from the state of vanadic acid to that of vanadous oxide, and reciprocally as long as there remains a trace of aniline to oxidize or of chlorate to decompose.

In order that a metal may aid in the production of aniline black it must possess at least two degrees of oxidation in the moist way. Thus potassium, sodium, lithium, calcium, magnesium, barium, aluminium, zinc, cadmium, lead, silver, and all analogous metals, are incapable of taking part in the production of aniline black.

But if a metal has two stages of oxidation in the moist way, it must not pass with too great facility from one of these states to the other.*

Thus protochloride of tin is improper for the preparation of aniline black. In fact this salt absorbs oxygen and chlorine with such avidity that it decomposes a certain quantity of chlorate of potash, but it absorbs the products of the decomposition, and does not yield even the smallest portion to the aniline. We may thus, at pleasure, retard the formation of aniline black, even in mixtures containing vanadium. The formation of aniline black does not begin till all the tin is peroxidized, and when the black makes its appearance it can be made to disappear again by adding fresh quantities of the protochloride of tin. If we take the higher oxide of a metal having two stages of oxidation we may produce bodies analogous to aniline black, provided that the salt passes readily to the lower oxide. Thus, permanganate, bichromate, ferrate of potassa, and bivanadate of ammonia form with hydrochlorate of aniline bodies analogous to aniline black, and that without the intervention of chlorates. Alkaline tungstates and molybdates are not favorable to the production of blacks. If we take the lower oxide of a metal having two stages of oxidation, we may, in presence of chlorate of potash, obtain aniline black. The lower oxides of cerium, iron, and manganese are here included, as well as those of nickel, cobalt, and chrome. These latter become peroxidized with difficulty, and are not very fit for the purpose, but in presence of 1–5000th of a salt of vanadium they aid in the formation of black.

The lower oxides of uranium, tungsten, and molybdenum, yield alone very fine blacks. But the higher oxide of uranium, like the tungstates and molybdates, does not act. When the salts of uranium seem to form black, as M. Pinkney considers that he has observed, it is because the salt of uranium has been obtained from a pitch blende containing vanadium.

Copper passes readily from the maximum to the minimum state of oxidation, and still more readily in the inverse direction: consequently, next to vanadium, it is the metal best suited for the production of black, and the one generally employed. The quantity of salt of vanadium necessary to transform aniline into black is so small that it may be practically disregarded. Hence we infer that metallic salts, though necessary in the formation of aniline black, do not enter into its constitution. Aniline black with vanadium is identical with aniline black with copper, the one containing no vanadium, and the other no copper.

M. Coquillion states that he has obtained aniline blacks by electrolysis. The author has obtained them still more readily by introducing into a very concentrated solution of a chlorate and of a salt of aniline a few drops of hydrochloric acid. No metal intervenes, but the hydrochloric acid decomposes the chloric acid; and the products of this decomposition, reacting upon the aniline, transform it into black. In some hours the mass becomes a well characterized paste of aniline black.

This reaction is of no practical service, because the goods would be destroyed by the concentrated and acid liquids. Nevertheless, it proves that the salts of vanadium and copper serve merely to play in dilute liquids the same part which hydrochloric acid does in concentrated solutions. We may say without hesitation that aniline black is the result of the action of the decomposition products of chloric acid upon aniline.

The reaction of vanadium enables us to study the behavior of these decomposition products of chloric acid upon a number of organic bodies, and upon the isomers of aniline. Starch, dextrin, and isinglass are converted into pale yellow substances which do not dye. Extract of logwood, if treated with chlorate of potash and a drop of salt of vanadium, is transformed into a yellow substance, which dyes silk a splendid gold-yellow. Under the same circumstances the solution of hydrochlorate of toluydin (made from solid toluydin) is transformed into a new substance, which dyes silk a pleasing bronze with coppery lustre.

All these reactions are plainly due to the decomposition products of chloric acid, and have all been reproduced with the substitution of copper for vanadium. However, copper has to be employed in proportions from 1000 to 1500 times greater than vanadium to obtain the same results. Chloride of vanadium is indirectly the best reagent for aniline, and, conversely, a mixture of hydrochlorate of aniline and chlorate of potash is the best reagent for vanadium. If the substance supposed to contain aniline is evaporated with a slight excess of hydrochloric acid, adding chlorate of potash and a drop of a weak solution of vanadous chlorate, aniline black makes its appearance, whatever foreign bodies may be present. (Protochloride of tin?)

On the other hand, the presence of vanadium may be detected by concentrating the solution, acidifying with hydrochloric acid, and treating with a mixture of a salt of aniline and a chlorate. If aniline black is formed rapidly in the cold the presence of vanadium is a certainty.

The author draws the following conclusions from his examination of aniline blacks:

Aniline black is simply emeraldin dehydrated.

An elevated temperature in the aging-rooms is necessary, not to form emeraldin, but to dehydrate it, and convert it into black.

Emeraldin may be dehydrated by the application of heat, even in the liquid in which it is formed. In other words, emeraldin is transformed into aniline black just as the blue hydrous oxide of copper is converted into the black anhydrous oxide by ebullition.

The essential characteristic of hydrated aniline black, or emeraldin, is that it can be completely dissolved or destroyed by the yellow sulphide of ammonium.

The essential characteristic of anhydrous emeraldin, or fixed aniline black, is that it is very slightly affected by the sulphide of ammonium. This reagent always points out whether emeraldin has or has not been transformed into black.

The characters just recited are those of the blacks produced from chemically pure aniline—the finest blacks which can be obtained.

The blacks prepared from commercial anilines are formed of emeraldin, mauvein, violanilin, and toluydin bronze.

If the commercial anilines are completely oxidized, the aniline is converted into emeraldin, and the toluydin into bronze. The mauvein and violanilin disappear almost entirely, and the emeraldin, being insoluble in acids and alcohols, may be separated from the toluydin bronze which is soluble in the same liquids.

By means of this reaction aniline in commercial aniline oils may be determined, being thrown down as emeraldin, and weighed as aniline black.

Typical aniline black is anhydrous emeraldin, but in practice there are as many aniline blacks as there are mixtures of aniline and its homologues.

The liquid toluydins of commerce behave like mixtures of aniline and of crystalline toluydin, and yield with chlorate of potash and vanadium mixtures of emeraldin and toluydin bronze.

Vanadium will render great service to organic chemistry, and wil revolutionize the preparation of aniline black.—*Bulletin de la Société Chimique de Paris.*

* This seems scarcely consistent with the previous passage, where the author states that "no metal passes with more facility from the minimum to the maximum state than vanadium."

ON ELECTROLYTIC ANILINE-BLACK.

BY M. FR. GOPPELSOEDER.

IF a galvanic current, weak or strong, passes through an aqueous solution of the hydrochlorate, sulphate, or nitrate of aniline, whether cold or hot, dilute or concentrated, neutral or acid, there appears—in a longer or shorter time—a green deposit at the positive pole, which passes by way of violet and bluish violet to a deep indigo-blue. The tartrate, oxalate, and acetate of aniline yield merely a brown deposit, accompanied by a little green. If we reverse the poles decoloration appears at that which was previously positive, and the same colors are reproduced at the pole which had been negative.

The reaction is very sensitive, for 1 m.grm. of hydrochlorate of aniline dissolved in 60 c.c. of water gives in a few hours a green deposit at the positive pole. With a solution of 1 m. grm. of the same salt in 30 c.c. of water there appears not merely the green but also the blue and the violet reaction. With 2.5 m.grms. of hydrochlorate of aniline in 30 c.c. of liquid there was produced, in the course of two hours, a violet-blue deposit partially of a greenish gray; an hour later a brown coloration of the liquid, and still later a very distinct green reaction.

The liquid into which the positive electrode dips exhibits very different colors—sometimes yellow, orange-red, or violet. When the salt of aniline is entirely decomposed the liquid becomes colorless.

The cotton, filter-paper, wool, or silk employed to conduct the current from one vessel to another is coated with the same color as the electrode, and is even dyed a salmon-brown, a green, gray, or red, the liquid containing different coloring matters, which are separated by the capilarity of the fibres. In place of these conductors amianthus may be employed.

The negative electrode is merely covered with a slight black shade, and there is produced at most a light yellowish brown deposit at the bottom of the vessel. The liquid at this pole is colored a yellow or reddish brown, the conductors being dyed analogous shades.

The green deposit obtained in the first place at the positive pole is a body unalterable by ozone when dry, but in ammonia it turns a greenish blue, and subsequently blue. After the ammonia has evaporated it becomes again blue. The green deposit from the positive pole, when moist is affected by ozone, and becomes a deep violet-blue if heated with a solution of bichromate of potassium, but if treated with a strong acid turns green again. As for the deep indigo-blue deposit, it is a mixture of several coloring-matters, among which is aniline-black, from which the other colors may be separated by ordinary solvents, such as water, alcohol, ether, benzol, acids, and dilute alkalies. The quality and quantity of these coloring-matters accompanying the black depend on the nature and concentration of the liquid, the strength of the battery, the temperature, and other accessory circumstances.

The deposit at the positive pole after purification is a fine crystalline black, of metallic lustre, not capable of sublimation; insoluble in water, the alcohols, benzol and its homologues; unalterable by weak acids, even at the point of ebullition, but turning green if boiled with concentrated acetic acid. It resists the action of reducing and oxidizing agents; it is unaffected by ozone, either in the dry or the wet state—by electrolytic oxygen and hydrogen, by nascent hydrogen, and by chlorine water. It is not soluble in alkaline solutions, but is in part modified, since alcohol subsequently extracts a blue coloring-matter, which becomes green with ammonia and yellow with acids.

The electrolytic black heated with alcohol, under pressure, colors it a deep violet, which becomes more beautiful if treated with alkalies, and is unalterable in dilute acids. The electrolytic black dissolves in sulphuric acid. The solution is violet, blue-green, or brown according as the sulphuric acid reacts more or less energetically upon the black. The violet, blue, and green sulphuric solutions if poured into water give a green precipitate. The filtrate is colorless or reddish, and in the latter case contains a red substance the alcoholic solution of which, mixed with ammonia, is a fine rose color, having a beautiful fluorescence like that of naphthalin-rose.

The green precipitate obtained from the sulphuric solution of the black poured into water is insoluble in ordinary solvents, but it may be suspended in water so finely that it appears to be dissolved. This green dissolves in hot sulphuric acid with a dirty violet-color, and is re-precipitated by water. If submitted to prolonged heating with sulphuric acid the water takes a rose-color, and with ammonia becomes of a bluish color with a yellow fluorescence. With caustic potassa it becomes bluish, and the filtrate is red. Ammonia renders the green violet, and even black, but acetic acid converts it to a green again. After the addition of ammonia, or of a fixed alkali, the aqueous liquid in which the green is suspended becomes of an intense blue, but the coloring-matter is still merely suspended, a minimum portion only dissolving, for the filtrate has a faint violet-blue color. Nascent hydrogen decolorizes it by degrees.

If heated to redness in a combustion-tube, with a mixture of lime and soda, electrolytic black disengages white vapors, which have the odor of aniline, and which turn turmeric brown. If a stronger heat is applied ammonia is obtained. If the layer of soda-lime is not very long a violet sublimate is obtained at the same time, soluble in alcohol, with a violet-blue color by transmitted daylight, but violet-red in artificial light. The liquid is rendered green by hydrochloric acid, and the blue color is restored by alkalies. The presence of nitrogen in the electrolytic black has also been demonstrated by the potassium reaction.

An optical examination of the electrolytic black has shown that it is more black than the other aniline-blacks with which it has been compared.

The author announces his intention of shortly laying before the Academy the results of an elementary analysis of these bodies most carefully purified.—*Comptes Rendus.*

SYNTHESIS OF VANILLIN.

ACCORDING to a communication recently read before the Berlin Chemical Society by Ferdinand Tiemann, vanillin, the odorous principle of vanilla, must now be added to the list of substances that can be prepared synthetically. The stages of the process are as follows: The reaction between potassium carbolate and carbonic acid yields paraoxy benzoic acid (the analogous reaction with sodium carbolate giving salicylic acid); from paraoxybenzoic acid protocatechuic acid can be prepared, and from protocatechuic acid may be obtained dimethylprotocatechuic acid. When the latter is heated with dilute hydrochloric acid in a sealed tube to 130° or 140° C., among the products of decomposition is found monomethylprotocatechuic or vanillic acid, of which vanillin is the corresponding aldehyd. The retrograde conversion of the acid into the aldehyd has been effected and perfectly pure crystals of vanillin have been thus obtained. The other products of the decomposition of vanillic acid were carbonic acid and guaiacol, the latter boiling at 200 C. and corresponding in every respect with that obtained from beech-wood tar.

A DANGEROUS PRESCRIPTION.

AN explosion is reported as having taken place in a French pharmacy during the dispensing of a prescription ordering half a gram of chromic acid and four grams of glycerine. The pupil to whom it was intrusted dissolved the acid in a bottle in a little water, then added the glycerine and shook the whole together. This operation was followed immediately by a loud report, and the contents of the bottle were projected to the ceiling of the pharmacy.

[American Chemist.]

CHEMICAL NOTES FROM FOREIGN AND AMERICAN JOURNALS.

PREPARATION OF PURE NICKEL SALTS FROM COMMERCIAL NICKEL.—TERREIL.—Nickel is dissolved in aqua regia, evaporated to dryness, redissolved in water (which leaves some arseniate of iron), metallic iron added, which precipitates the copper, the filtered solution oxidized, evaporated to dryness with enough sulphuric acid to convert the metals into sulphates, dissolved and treated with barium carbonate, which precipitates the iron sulphate and leaves a solution of pure nickel sulphate.

ON THE ACTION OF GASEOUS PHOSPHURETTED HYDROGEN ON THE ANIMAL SYSTEM.—P. GAILLARD.—In order to decide whether the poisonous properties of phosphorus are due to the formation of phosphuretted hydrogen in the system, the author subjected different animals to the action of air containing a small quantity of phosphuretted hydrogen, and found one five-hundredth part of this gas sufficient to cause death.

ON CHEMICAL AND PHYSIOLOGICAL FERMENTS.—A. MUNTZ.—By the aid of chloroform it is easy to distinguish between fermentation depending on life, which is entirely prevented by the use of the reagent, and fermentation being a chemical process, which is neither prevented nor retarded by the same reagent.

ON THE TRANSFORMATION OF CAMPHOR INTO CAMPHENE, AND VICE VERSA.—J. RIBAN.—Camphor is converted into borneol, $C_{10}H_{16}O+H_2=C_{10}H_{18}O$, which in turn yields a chlorhydric ether, $C_{10}H_{18}O+HCl=C_{10}H_{16}HCl+H_2O$, and this, with alcoholic potassa, yields camphene, $C_{10}H_{16}HCl+KOH=C_{10}H_{16}+KCl+H_2O$. Camphene, from French spirits of turpentine, when oxidized with bichromate and dilute sulphuric acid, in quantity not sufficient to dissolve the oxides which are formed, yields camphor.

ON SOME REACTIONS OF SALTS OF CHROMIUM.—A. ETARD.—The green chrome salts are immediately converted into the violet modification by the addition of a small quantity of potassium nitrite, when cold. Potassium sulphocyanide has the same effect, but more slowly. The violet salts turn green by arsenites or free arsenic acid; nitrites then do not change them back to violet, and the arsenic acid is not precipitated by silver nitrate.

ON A REAGENT FOR DISTINGUISHING FREE CARBONIC ACID IN WATER FROM THAT WHICH IS UNITED TO BASES.—PROF. DR. VON PETTENKOFER.—Rosolic acid is colored red by the carbonates and bicarbonates of the alkalies and alkaline earths, but is decolorized by free carbonic acid. One part pure rosolic acid is dissolved in 500 parts 80 per cent alcohol, and neutralized with caustic baryta until it begins to turn red. About half a cubic centimetre of this solution is added to 50 c. c. of water. If the water remains colorless or yellow, it contains free carbonic acid; but if only the bicarbonates are present, it turns red. If the solution remains colorless, owing to the presence of free carbonic acid, the quantity of dilute limewater required to produce the red shade indicates the quantity of free acid approximately.

NEW PROCESS FOR RECOVERING EVERY TRACE OF GOLD AND SILVER FROM ELECTRO-PLATING SOLUTIONS NO LONGER USEFUL.—PROF. BOETTGER.—Gold solutions, usually cyanides, are boiled in a porcelain dish, sodic stannate added, and the boiling continued until all the gold has combined with the tin, forming a black precipitate. This precipitate is washed with water, and dissolved in aqua regia. The solution of auric and stannic chlorides is carefully evaporated, diluted with distilled water, enough sodio-potassic tartrate added and warmed, when all the gold will be precipitated as a brownish yellow powder. For silver solutions it is only necessary to boil with sodic stannate.

MANUFACTURE OF LIME SOAP FROM THE WASTE WATERS OF CLOTH WORKS, AND ITS USE IN MAKING ILLUMINATING GAS.—LANDOLT and STAHLSCHMIDT.—Milk of lime is mixed with the first wash-water, and a soap is formed in the cold, which soon settles. When air-dried, this soap contains 3.11 per cent water, 18.47 lime and oxide of iron, 71.96 fatty acids, and 6.46 wool-fibre, dye-stuff, etc. By decomposing this soap with acid, a fatty substance fit for distillation is at once obtained.

SIMPLE METHOD FOR COVERING BRASS AND COPPER WITH A BRILLIANT FILM OF ZINC.—PROF. BOETTGER.—The article to be coated is boiled in a solution of sodic or potassic zincate made by boiling zinc-dust in a concentrated soda or potash lye. If a copper article thus coated be heated to 120° or 140° C. in olive oil, it acquires a golden color like tombak.

GAS HYDROMETER OF MAUMENÉ.—This is a new apparatus for the measuring of gas evolved in certain analytical processes. It consists of a generating flask or bottle, in which is placed the substance to be analyzed, such as carbonate, and also a small tube holding acid. This is connected by the tube with a rubber bottle, held in a copper cylinder. This latter is filled with water; the air in the bag is thus forced out. The bottle containing acid in the generator is upset, the gas evolved causes an expansion of the bag, and a certain volume of water is forced out and run into a graduated cylinder, and may be measured. This apparatus is not only used in the determination of CO_2 in a limestone, but also in alkalimetry, acidimetry, and in many other analytical methods in which a gas is to be measured.

ON SALTS WHICH THE BEET EXTRACTS FROM THE SOIL.—E. PELIGOT.—An article treating of experiments conducted in the raising of the beet. He finds in some cases, contrary to the general opinion, that the beet which contains the most sugar is long and irregular in form; the amount of sugar is not affected by the presence of chlorides; these chlorides he states are most injurious in the subsequent manufacture of sugar. There is a limit as-regards the amount of chlorides absorbed. The chlorides are concentrated in the upper part of the beet. The longer central axis is richer in water and soluble salts than the surrounding part. Beets fertilized with a phosphate are found to contain more alkaline salts, less lime, and no increase in phosphoric acid. Phosphate of lime is decomposed by the magnesia and alkaline salts present. The action of phosphates appears similar to that of sulphate of lime, which appears to cause an assimilation of alkaline salts.

The juice holds soluble salts; phosphate of lime and carbonate of lime, held in solution by CO_2, which is present in the cells of beet, are precipitated by boiling. Phosphoric acid is, however, present in the form of tribasic phosphate of potash and phosphate of ammonia and magnesia. The weak acids of the juice probably hold the latter substances in solution. This phosphate of lime has been discovered to be the cause of the opalescence met with in the manufacture of crystal glass, when potash from the refinery has been used. Foreign potash does not contain this impurity.

BLACK AND ITS ARTIFICIAL PREPARATION.—M. MELSENS.—Marl is impregnated with a solution of phosphate of lime and the whole calcined. An excellent black made, but not as dense as the ordinary bone-black. The dark acid from the manufacture of glycerine is used to dissolve the phosphate. Black made with addition of sulphate of ammonia did not give good results. This artificial black absorbs lime. The writer has noticed a condensation of lime in solution upon solid phosphate.

POTASSIC XANTHOGENATE AS A REMEDY AGAINST PHYLLOXERA.—PH. FŒLLER and E. A. GRETE.—The salt does not interfere with plant-growth even when brought near the roots of the plants in considerable quantity. Instead of using ethyl alcohol in the preparation of the salt, crude amyl alcohol may be used. Conc. caustic potash is agitated with amyl alcohol, and bisulphide of carbon then added. This gives directly, in a form ready for use, potassic amyl xanthogenate. This is recommended as a remedy not only against phylloxera, but against any other plant-infesting insects.

TRIMETHYLCARBINOL.—When chlorine is allowed to act upon trimethylcarbinol, the products obtained are water and pentachlorbutylene. Ethylidene oxychloride and chlorine gave an ether containing eight chlorine atoms in the molecule. The decomposition of water by the electric current is looked upon as a breaking up into OH and H; the oxygen being formed by a breaking up of OH thus—

$$2OH=H_2O+O.$$

Ethylpropylcarbinol was obtained by subjecting to dry distillation a mixture of calcic butyrate and propionate; and then treating the ketone thus obtained with sodium amalgam. It has been found that soluble Prussian blue, $K_2Fe_2(\overset{II}{Fe_2})\overset{VI}{Cy}_{12}$, may be obtained from yellow prussiate of potassium by the action of ferri-compounds, as well as from the red prussiate by the action of ferro-compounds. Soluble Prussian blue gives a precipitate of Turnbull's blue with a ferro-salt. A series of investigations show that in many cases the products obtained by the oxidation of organic substances depend upon the nature of the oxidizing agent employed. On the other hand, the law of Popoff concerning the oxidation of ketones was found to hold good, no matter what the oxidizing agent might be.

ACTION OF EARTH ON ORGANIC NITROGEN.—E. C. C. STANFORD.—The author has made a series of experiments on mixtures of earth and meat exactly similar to his previous experiments with charcoal, with a view to elucidate the action of the earth in the earth-closet. The mixtures experimented upon consisted of 1000 grains of lean meat, and 1000, 2000 and 3000 grains of dry earth respectively. They were tested from time to time for nitrates, and the nitrogen was determined. He concludes: 1st, earth mixed with organic nitrogenous matter is an indifferent drier, and, except in large quantity, a poor deodorizer. 2d, such mixtures continully lose nitrogen, to the extent even of 73 per cent in five months. 3d, the loss is due to decay, the nitrogen being evolved as ammonia. 4th, the earth does not act as an oxidizer, and no nitrification takes place.

ON THE QUANTITATIVE DETERMINATION OF TELLURIUM BY MEANS OF GRAPE AND INVERTED SUGAR.—LUD. KASTNER.—This method, originally proposed by Stolba, is highly recommended. The best results were obtained when the determinations were made in the form of tellurous acid.

ON THE SEPARATION OF TIN FROM ANTIMONY AND ARSENIC.—DR. CLEMENS WINKLER.—The three metals are obtained in solution in the highest state of oxidation with addition of tartaric acid. After dilution, $CaCl_2$ is added in such quantity that the subsequently precipitated $CaCO_3$ shall be at least fifteen times as much as the SnO_2, after which the liquid is neutralized with K_2CO_3. Precipitation is then accomplished by the use of KCy, after which a slight excess of K_2CO_3 is added. The liquid is then heated almost to boiling temperature, whereby the mixed precipitates become granular, and are easily filtered. Thus the tin is entirely separated from antimony and arsenic.

SPONTANEOUS PRODUCTION OF CRYSTALS IN EGGS WITHOUT DEVELOPMENT OF ORGANISM.—M. GAYON.—The eggs experimented upon were apparently without alteration, neither acid nor putrid fermentation, nor could any microscopic organisms be discovered in the interior, exterior, or membrane. The crystals appeared principally in the air-chamber; on analysis proved to be tyrosine and leucine.

ACTION OF CHLORIDE OF CYANOGEN, GASEOUS AND SOLID, UPON CUMINIC ALCOHOL.—P. SPICA.—The author by the action of the gaseous chloride obtains cumilic carbammate, containing 68.34 per cent of carbon and 7.53 of hydrogen.

DECOMPOSITION OF WATER BY PLATINUM.—MM. H. STE.-CLAIRE DEVILLE and H. DEBRAY.—If we heat in a glass tube raised to 500° to 600° cyanide of potassium near to a boat full of warm water, a vacuum having been made beforehand, the pressure reaches at most half an atmosphere, and remains constant for some hours. But if we mix with the cyanide of potassium some platinum-sponge hydrogen gas is evolved in quantity, and there is formed a double cyanide of platinum and potassium. The hydrogen is impure, being accompanied not merely with ammonia, but with $4\frac{1}{2}$ to 12 per cent of carbonic oxide. If the heat exceeds dull redness, carbonate of ammonia sublimes. A concentrated solution of cyanide of potassium attacks platinum at the boiling-point. The metal is converted into the double cyanide, with an escape of pure hydrogen. Cyanide of mercury dissolved in water is not precipitated by platinum, even at the boiling point; but if a little cyanide of potassium is added, mercury is immediately liberated, and combines with the platinum.

CONSTITUTION OF THE GELATINOUS SUBSTANCES.—MM. P. SCHUTZENBERGER and A. BOURGEOIS—These researches relate to isinglass, ossein, gelatin, and the chondrin obtained from the costal cartilages of a calf. As in the albumenoid bodies and fibrin, the nitrogen evolved as ammonia on the one hand, and the carbonic and oxalic acids on the other, are in such ratios that the simultaneous production of these three bodies may be considered as connected with the hydration of urea and oxamide.

INFLUENCE OF DIFFERENT MANURIAL ELEMENTS ON THE GROWTH OF THE BEET, AND ON ITS PROPORTION OF SUGAR.—M. H. JOULIE.—Phosphoric acid increases the proportion of sugar. Potash has not this effect, but renders the roots more saline and of worse quality. Nitrate of soda is favorable to the gross yield without injuring the quality. Assimilable nitrogen is favorable to the yield, without injury to the quality, if applied in moderate doses, beyond which it is hurtful both to quality and weight. Nitrogen in nitrates is preferable to nitrogen in ammonia.

ACTION OF COLD UPON MILK AND ITS PRODUCTS.—M. E. TISSERAND.—The author find that the cream separates the more rapidly the nearer the milk has been brought to the freezing-point, its volume being also increased. The yield in butter is also greater when the milk has been exposed to a low temperature, when both skimmed milk, butter, and cheese are of better quality (?).

MAGNETIC ACTION ON THE RAREFIED GASES OF GEISSLER'S TUBES.—M. J. CHAUTARD.—The author states that it is perfectly well known that gases, and even metallic vapors, present spectra which differ according to the conditions in which they are accidentally placed, among which are temperature, pressure, and the combinations in which the substances occur. The experiments which he has made enable him to add to these modifying causes the action of a powerful electro-magnet. He insists that every spectroscopic observer, before attempting to calculate the numerical results of his experiments, should first determine his peculiar personal error.

ACTION OF HEAT IN MAGNETIZATION.—M. L. FAYE.—The following phenomena have been observed: The conservation of magnetism at any temperature as long as such temperature is constant; the decrease of the magnetism, slow at first and then rapid, and becoming very rapid at the expiration of a time which varies with the temperature of the magnetization; the increase of the residual quantity of magnetism after cooling, when the magnet is heated anew.

DETERMINATION OF THE ALKALINE METALS IN SILICATES AND SUBSTANCES NOT ATTACKED BY ACIDS BY MEANS OF HYDRATE OF BARYTA.—M. A. TERREIL.—The author attacks silicates with perfectly pure hydrate of baryta, fused and pulverized, using 7 to 8 parts to 1 of the silicate. The operation is performed in a silver crucible at 350°, the temperature being raised a little when the fused mass has again solidified, but so as not to reach dull redness. The mass, after cooling, is boiled in pure water in the crucible, and the filtrate is treated with a current of well-washed carbonic acid, raised to a boil, and filtered. The alkalies will be found in the filtrate.

SEPARATION OF ARSENIC FROM SULPHURIC ACID BY MEANS OF HYPOSULPHITE OF SODA.—M. THORN.—This method has been adopted in several manufactories of sulphuric acid. The arsenic is chiefly present in the chamber acid in the state of arsenious acid, but by the action of hyposulphite of sodium it is transformed into sulphide of arsenic and sulphate of soda. The manner of operating is as follows: The chamber acid at 50° B. is heated in a leaden vessel to 70° or 80°, with the addition of the necessary amount of hyposulphite (according to the arsenic present), either dissolved in water or as a powder. The whole is then well stirred. Sulphide of arsenic separates out, and collects in flakes on the surface of the acid, which is then drawn off from below. Only a very slight escape of sulphurous acid occurs if the operation is properly conducted. The purified acid contains 0.30 to 0.40 per cent of sulphate of soda, which, for most purposes, is not prejudicial. The quantity of arsenic in the raw acid at 50° B. varies from 0.098 to 0.004 per cent.

PHOSPHURETTED COPPER.—M. SCHWARTZ.—The author lines the crucible to be employed with a paste made of 14 parts silica, 18 parts bone-ash, 4 parts charcoal-powder, 4 parts soda, and 4 parts powdered glass, mixed with a solution of gum. The crucible is dried, the copper introduced and covered with the same mixture, and the lid luted on. The whole is then raised to a bright red heat. The copper is afterwards found to contain 3.25 per cent of phosphorus. In preparing phosphor-bronze the phosphide of copper is melted with such proportions of tin and copper that the whole may contain 0.5 per cent of phosphorus.

NEW METHOD OF FORMATION OF BENZYLATED PHENOL.—E. PATERNO and M. FILETTI.—The authors mix 40 grms. benzoic alcohol with 36 grms, of crystalline phenic acid, dilute the mixture with 140 grms of glacial acetic acid, and then cool with water, whilst gradually adding about $1\frac{1}{2}$ volumes of a mixture of equal volumes of commercial sulphuric acid and acetic acid.

ACTION OF LIGHT UPON NITRO-CUMINIC ACID.—E. PATERNO and M. FILETTI.—Nitro-cuminic acid is profoundly affected by the influence of light. Whether it is exposed to the direct solar rays or to diffused light, it takes a red color. The authors have traced the formation of a red substance of a decidedly acid character, and having an elementary composition very near that of the original acid.

BENZYLIC DERIVATIVES OF UREA AND SULPH-UREA.—E. PATERNO and P. SPICA.—The method employed by the authors has been to cause a salt of dibenzylamin to react upon the cyanate and sulphocyanate of potassium. In this manner they have prepared mono-benzyl-urea and mono-benzyl-sulphurea.

CYANIDE OF ACETYL.—M. FILETTI.—The author, having heated, for four to five hours, equivalent proportions of chloride of acetyl and dry cyanide of silver, and then submitted the result to fractional distillation, obtained three liquids. The first contained chloride of acetyl; the second portion containing the cyanide, boiled at 93°, and the third went over about 200°.

ON PARATOLUYLIC AMIDE.—P. SPICA.—This substance forms fine prismatic crystals, perfectly colorless, and slightly soluble in cold water, chloroform, and benzin, but freely soluble in boiling water, alcohol, and ether.

MUSHROOMS.—A. MUNTZ.—The author cites as a general rule that all mushrooms submitted to the action of oxygen, transform into alcohol and carbonic-acid sugars placed at their disposition; when this sugar is mannite, hydrogen is at the same time produced.

NEW REAGENT FOR MORPHIA.—Prof. E. SELMI.—The author takes glacial acetic acid, stirs it up for fifteen minutes with minium in fine powder, filters, and places a drop upon a plate of glass laid upon white paper. Upon this drop are put 2 or 3 drops of an aqueous solution of acetate of morphia, drying each time at a very gentle heat, so as to have at last a spot formed of the dry acetate of the alkaloid. From the first instant there appears a slight yellowness, which goes on increasing as the acetic acid evaporates, passing into a bright yellow, an orange, and a dark yellow. If left to spontaneous evaporation, the yellow gives place to a violet, which grows paler, and finishes by taking the color of lees of wine.

PREPARATION OF BICARBONATE OF POTASSA.—Dr. L. PESCI.—The author passes a current of carbonic acid into a solution of pure potassa in alcohol (absolute, or of 80 per cent) so that not all the carbonate may be transformed into bicarbonate. From the filtrate pure bicarbonate is deposited.

THE INTERNATIONAL EXHIBITION OF 1876.

THE PUMPING ENGINES: RECENT ARRIVALS, ETC.

No. V.

EARLY in the history of the work which had been undertaken by the Committee on grounds, plans, and buildings of the Centennial Commission, the necessity for a means of water supply for the buildings, lakes, fountains, and grounds within the Exhibition inclosure, independent of what could be obtained from the water-works of the city, made itself apparent, and they very soon arrived at the conclusion that the Commission must provide independent means of obtaining such supply. At this time Mr. Henry R. Worthington, of New-York, came forward with the very liberal offer to furnish for the elevation of the desired quantity of water one of his well-known duplex direct-acting steam pumping-engines of the largest class, free of cost to the Commission.

Accepting this generous offer, the Commission secured the services of Mr. Frederick Graff, formerly Chief Engineer of the City Water Department, and to him intrusted the design and construction of the engine-house, stand-pipe, and necessary fixtures and accessories, as well as the laying of the supply mains, and subsequently entered into a contract with him for the execution of the entire work, except the pumping-engines and their boilers.

On this page will be found a representation of the handsome brick, slate-roofed building which has been erected upon the south bank of the Schuylkill River for the inclosure of these engines and boilers. It is 70 feet 6 inches long by 39 feet 6 inches wide, divided into an engine-room, 45 x 38 feet, and a boiler-house, 38 by 23 feet, and is one story high. The neat brick chimney-stack is 80 feet high, with a flue 40 inches square.

In the engine-room is placed one Worthington duplex pumping-engine, capable of raising from five and one half to six millions of United States gallons of water in twenty-four hours. It is of the compound double cylinder variety, with two high-pressure steam-cylinders of 29 inches, and two low-pressure cylinders of 50¼ inches diameter, all of 50 inches stroke. These will operate two pumps with plungers 22½ inches diameter and 50 inches' stroke.

In the boiler-house are two boilers of 6 feet 6 inches diameter of shell and 18 feet long, each containing 96 four-inch tubes. They have been tested under a hydrostatic pressure of 120 pounds to the square inch, the steam pressure proposed to be carried in them being about 60 pounds.

In addition to the engines named there will be a high-pressure auxiliary engine and pumps for temporary use, in case of any accident to the larger ones, capable of raising to the necessary height one million gallons in twenty-four hours, and a small duplex pump for feeding the boilers.

The three engines just described, with their steam-pipes, foundations, boilers, and boiler-settings, are supplied and put in place ready for use during the whole of the term of the Exhibition, without any cost to the Centennial Commission.

The pumps take their supply from a large well in the engine-house, which is fed from the river through about 75 feet of 30-inch main, guarded by the proper screens at the inlet on the river and in the well. The ascending main is 18 inches in diameter and 958 feet long, from the pumps to the stand-pipe.

The latter, situated near the park drive, northward of Memorial Hall (also shown on page 233), is made of wrought-iron, four feet in diameter and 120 feet high from its base, with a finial 13 feet high surmounting it. For a height of 25 feet above the surface of the ground it is supported by masonry, of octagonal form, faced with green serpentine, with mouldings, roof, and dressings of Ohio sandstone, and altogether presents a very pleasing appearance to the eye.

The water will be pumped into this pipe to a height of about 208 feet above the level of Fairmount Dam, and about 108 feet above the floor of the main Exhibition building. From the stand-pipe a sixteen-inch main extends about 1300 feet to a point on Belmont Avenue between the Main and Machinery Halls, where it reduces to 12 inches; from this latter are supplied the three mains underlying Machinery Hall—described in my letter No. II.—and three similar ones under the floor of the Main Exhibition Building. Connected with these pipes, inside and immediately outside of the two buildings just named, are no less than 126 fire-hydrants.

Mains also extend to Horticultural and Agricultural Halls, and to the government and other buildings scattered about the grounds; the whole length of the mains connecting and within the various buildings will exceed six miles. The total number of fire-hydrants in the various buildings and within the Exhibition inclosure will be in the neighborhood of three hundred. The ten-inch main which supplies the lake at the north of Machinery Hall, does so through a fountain consisting of three concentric rings of jets of 50, 30, and 12 feet in diameter, from which will issue about two hundred jets of water.

Altogether this elaborate and expensive work would be sufficient to provide with water for domestic and fire purposes quite a respectable little city; and few people would have any idea that such extensive preparations were made

THE INTERNATIONAL EXHIBITION OF 1876.—THE AMERICAN RESTAURANT.—(*See page* 233.)

THE INTERNATIONAL EXHIBITION OF 1876.—PUMPING-ENGINE HOUSE OF WATER SUPPLY ON SCHUYLKILL RIVER, BELMONT LANDING.

for this purpose in passing over the grounds or through the buildings. The pumping-engines are necessarily located so far from that part of the grounds principally occupied by the various buildings that they will, in all probability, rarely be visited by the non-professional man; nevertheless they will form no insignificant unit in the sum-total of specimens of American engineering and workmanship which will be on exhibition; and it is to be hoped that, for the benefit of the profession, there will be kept—and doubtless there will be—an accurate record of the six months' performance of these pumps, from which their very liberal owner and designer may derive all the credit which they may be capable of bringing to him.

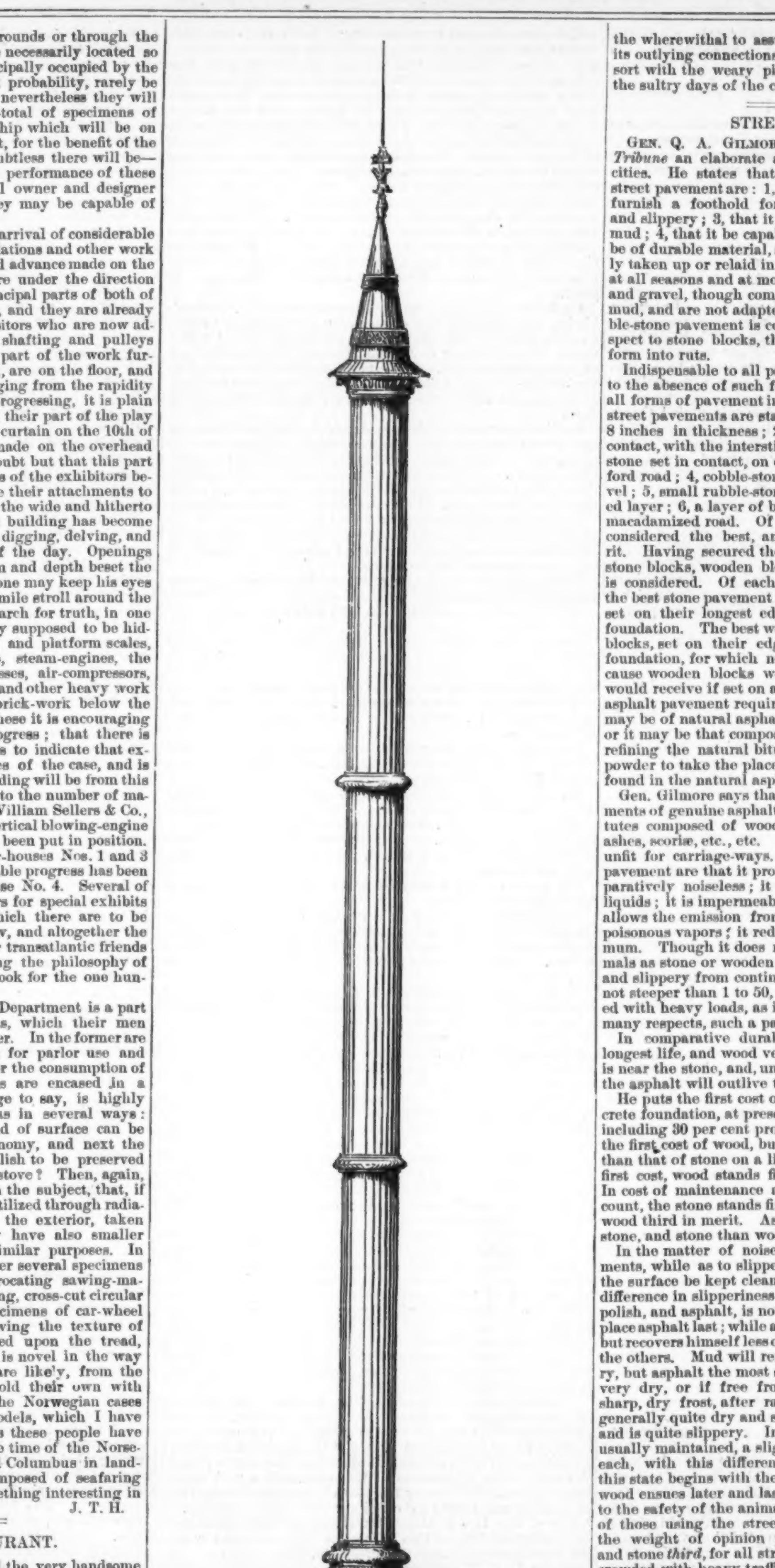
I am able to chronicle this week the arrival of considerable material for, and progress in, the foundations and other work in Machinery Hall, as well as very good advance made on the numerous outlying buildings, which are under the direction of the Bureau of Machinery. The principal parts of both of the large Corliss engines are together, and they are already the centre of attraction to the few visitors who are now admitted to the building. All the large shafting and pulleys for the underground lines, which are a part of the work furnished by the Corliss Steam-engine Co., are on the floor, and will very soon be in place; in fact, judging from the rapidity with which the work of this firm is progressing, it is plain that these gentlemen mean to have all their part of the play in readiness for the ringing up of the curtain on the 10th of May. Good progress has also been made on the overhead lines of shafting, and there is now no doubt but that this part of the work will be ready for the pulleys of the exhibitors before the latter will be prepared to make their attachments to them. Within the past few days, also, the wide and hitherto unbroken expanse of floor in the great building has become a Saturnalia of bricks and mortar; and digging, delving, and wheeling dirt has become the order of the day. Openings and pitfalls of every conceivable form and depth beset the pathway of the unwary straggler, and one may keep his eyes well about him in a three quarters of a mile stroll around the building lest he find himself, in his search for truth, in one of these depths where it is traditionally supposed to be hidden. All such engineering as railroad and platform scales, heavy grinding-mills, blowing-engines, steam-engines, the huge modern newspaper printing-presses, air-compressors, cotton-presses, india-rubber machinery, and other heavy work require deep and solid masonry and brick-work below the floor for their proper support; and of these it is encouraging to find that there are a multitude in progress; that there is stir enough being made in these matters to indicate that exhibitors are waking up to the necessities of the case, and is an earnest of what a busy hive this building will be from this on. A large addition has been made to the number of machine-tools from the establishment of William Sellers & Co., and some of the heavy parts of a large vertical blowing-engine by I. P. Morris and Co., of this city, has been put in position.

The annexes Nos. 1 and 2 and boiler-houses Nos. 1 and 3 are very nearly completed, and considerable progress has been made on the third annex and boiler-house No. 4. Several of the buildings to be erected by exhibitors for special exhibits under the Bureau of Machinery—of which there are to be quite a number—are also rising into view, and altogether the week just past gives promise that our transatlantic friends will be under no necessity of exercising the philosophy of poor Mark Tapley when they come to look for the one hundred buildings they are promised.

Among the arrivals in the Machinery Department is a part of the Swedish and Norwegian exhibits, which their men are busily unpacking and putting together. In the former are some quite curious-looking stoves, both for parlor use and cooking purposes. They are intended for the consumption of either wood or coal. The parlor-stoves are encased in a thin corrugated jacket, which, strange to say, is highly polished. This will appear curious to us in several ways: first, as to how the polishing on this kind of surface can be done with any commercial degree of economy, and next the query will suggest itself, how is this polish to be preserved when subjected to the temperature of a stove? Then, again, we may reason, from all known laws on the subject, that, if much of the heat from the fuel is to be utilized through radiation, they have not, in this polishing of the exterior, taken the very best means to that end. They have also smaller stoves for the heating of sad-irons and similar purposes. In addition to these they are putting together several specimens of rather heavy-looking vertical, reciprocating sawing-machines, an edging-saw and radial, swinging, cross-cut circular saw, as well as a large number of specimens of car-wheel iron in purposely broken fragments showing the texture of the metal, the depth to which it is chilled upon the tread, etc. If they do not show us much that is novel in the way of stoves and sawing-machinery, they are likely, from the known excellence of Swedish irons, to hold their own with us in that branch of their exhibit. In the Norwegian cases are sundry specimens of ship-building models, which I have not been able as yet to examine; but as these people have maritime traditions extending back to the time of the Norsemen who are supposed to have antedated Columbus in landing on these shores, and are largely composed of seafaring men and fishermen, we may look for something interesting in these models. J. T. H.

THE AMERICAN RESTAURANT.

On the preceding page is represented the very handsome building in course of construction on the Centennial grounds, and nearly completed, which is known by the above caption. It is being erected by Messrs. Tobiason and Heilbron, of this city, and for the purpose is probably as complete and elegant in all its arrangements as could be desired by the most fastidious tastes. The main banqueting hall on the right is an elegant and lofty room 50 x 100 feet; the dining hall occupying a part of the central building is 30 x 50 feet, and the pavilion on the left, together with the portico connecting it with the central building, is 16 x 100 feet. A portico also extends along the entire front of the central part, making in all an extent of out-door, but covered, accommodation for the consumers of ice-cream and kindred light refreshments of 20 x 220 feet. The building in the centre also contains ladies' and gentlemen's parlors, retiring-rooms, etc., and all the necessary apartments for the preparation of the viands and refreshments, all of which are to be fitted up and furnished on the most complete and improved plans. The central portico and pavilion faces almost directly upon Horticultural Hall and its surrounding grounds and flower-beds; and on the left of the pavilion is a very fine grove of cedars, within which will be placed extensive accommodations for the refreshment of those who may prefer to take such in the open air. In view of the attractive situation and the thorough provisions made for administering to the thirsty and hungry the wherewithal to assuage their longings, this building and its outlying connections will no doubt become a favorite resort with the weary pilgrim to the American Mecca during the sultry days of the coming summer.



THE STAND-PIPE.

STREET PAVEMENTS.

GEN. Q. A. GILMORE has contributed to the New-York *Tribune* an elaborate article on street pavements in large cities. He states that the essential requisites of a good street pavement are: 1, that it be smooth and hard; 2, that it furnish a foothold for animals, and not become polished and slippery; 3, that it be noiseless and free from dust and mud; 4, that it be capable of thorough cleaning; 5, that it be of durable material, and of such construction as to be easily taken up or relaid in places; 6, that it be easily repaired at all seasons and at moderate cost. Roads of broken stone and gravel, though comparatively noiseless, furnish dust and mud, and are not adapted to the heavy travel of cities. Cobble-stone pavement is condemned as far inferior in every respect to stone blocks, though these, if laid on sand, rapidly form into ruts.

Indispensable to all paved streets is a good foundation, and to the absence of such foundation is attributed the failure of all forms of pavement in cities. The suitable foundations for street pavements are stated to be: 1, hydraulic concrete 6 to 8 inches in thickness; 2, rubble-stone set on edge, but not in contact, with the interstices filled in with concrete; 3, rubble-stone set in contact, on edge, like the sub-pavement of a Telford road; 4, cobble-stone firmly set in a form of sand or gravel; 5, small rubble-stones of random sizes in a well-compacted layer; 6, a layer of broken stone laid in the manner of a macadamized road. Of these, the first, second, and third are considered the best, and are named in the order of merit. Having secured these foundations, the relative value of stone blocks, wooden blocks, and asphalt for the pavements is considered. Of each of these general kinds of pavement, the best stone pavement is one composed of rectangular blocks set on their longest edge across the street, upon a concrete foundation. The best wooden pavement is one of rectangular blocks, set on their edges across the street, on a suitable foundation, for which none of those mentioned are good, because wooden blocks would not endure the crushing they would receive if set on a hard, inelastic foundation. A good asphalt pavement required a firm foundation. The asphalt may be of natural asphalt rock, obtained from Switzerland, or it may be that composed of asphaltic cement, prepared by refining the natural bitumen, to which is added a calcareous powder to take the place of the amorphous carbonate of lime found in the natural asphalt rock.

Gen. Gilmore says that there is a distinction between pavements of genuine asphalt and the patented imitations or substitutes composed of wood-tar, coal-tar, etc., mixed with sand, ashes, scoriæ, etc., etc. All of these mixtures he pronounces unfit for carriage-ways. The advantages of a good asphalt pavement are that it produces no dust and no mud; it is comparatively noiseless; it does not absorb and retain noxious liquids; it is impermeable to moisture, and neither emits nor allows the emission from the subsoil of unwholesome and poisonous vapors; it reduces the force of traction to a minimum. Though it does not give as secure a foothold for animals as stone or wooden blocks, it does not become polished and slippery from continued wear. It is adapted to all streets not steeper than 1 to 50, except those that are thickly crowded with heavy loads, as in Broadway below Canal street. In many respects, such a pavement stands unrivalled.

In comparative durability, stone blocks will have the longest life, and wood very much the shortest; the asphalt is near the stone, and, unless the latter be of superior quality, the asphalt will outlive the stone.

He puts the first cost of a good asphalt pavement on a concrete foundation, at present prices, at $3.50 per square yard, including 30 per cent profit to the contractor. This exceeds the first cost of wood, but it is less by at least $1 per yard than that of stone on a like foundation. As to cheapness in first cost, wood stands first, asphalt second, and stone third. In cost of maintenance and repair, taking durability into account, the stone stands first, asphalt nearly the same, and the wood third in merit. Asphalt is easier cleaned than wood or stone, and stone than wood.

In the matter of noise, stone is the noisiest of all pavements, while as to slipperiness the case is thus stated: "If the surface be kept clean by either sweeping or washing, the difference in slipperiness between wood, stone that does not polish, and asphalt, is not great, although enough perhaps to place asphalt last; while a horse not only falls more frequently, but recovers himself less often and less easily upon it than upon the others. Mud will render either of the pavements slippery, but asphalt the most so, although it is not slippery when very dry, or if free from mud when very wet. Under a sharp, dry frost, after rain or snow, asphalt and stone are generally quite dry and safe, while wood retains its moisture and is quite slippery. In the condition in which they are usually maintained, a slight rain adds to the slipperiness of each, with this difference, that, upon asphalt and stone, this state begins with the rain, while the worst condition of wood ensues later and lasts longer. With regard, therefore, to the safety of the animals and the convenience and comfort of those using the street, as well as those living upon it, the weight of opinion places asphalt *first*, wood *second*, and stone *third*, for all streets except those that are habitually crowded with heavy traffic, in which case stone would rise to the *first* place and asphalt drop to the *third*."

It is asserted that the pavements of a city exert a direct and powerful influence upon the health of the population, and this branch of the subject is discussed elaborately. The joints in pavements of wood and stone become in time equal to one third of the whole surface, and they become filled, and the surface of filth exposed to evaporation covers three-fourths of the whole street. This foul organic matter is held in the joints and gutters, and undergoes putrefactive fermentation in warm, damp weather.

The conclusion which Gen. Gilmore reaches is that, for the streets of New-York, "the best pavement for all the busiest streets, where the traffic is dense, heavy, and crowded, is one of rectangular stone blocks set on a concrete foundation; and the next best is one of cubical blocks, known as the Belgian pavement, set in the same manner. The best pavement for streets of ample width, upon which the daily traffic is not crowded, or for streets largely devoted to light traffic or pleasure-driving, or lined on either side with residences, is asphalt for all grades not steeper than 1 in 48 or 50."

THE bill appropriating $15,000 for the Centennial was passed by the Maryland Legislature, March 13th. The bill providing for the representation of Kentucky has also become a law.

[American Journal of Science and Arts.]

ON THE VEILED SOLAR SPOTS.

By L. Trouvelot, Cambridge, Mass.

[Abstract of a paper read before the American Academy, 1875.]

It is now pretty well established that the visible surface of the sun is a gaseous envelope called "the chromosphere," mainly composed of incandescent hydrogen gas, with which are occasionally associated some metallic vapors, usually occupying the lower strata. To all appearances, the granulations called "rice-grains," the faculæ and the protuberances, are phenomena belonging to the chromosphere; in fact, they are the chromosphere itself seen under the particular forms and aspects peculiar to it. Ordinarily this envelope has a thickness of 10" or 15". This thickness, however, is by no means constant, varying from day to day within certain narrow limits.

At no time since I have observed the sun have I seen the chromosphere so thin and shallow as during the present year, and especially between June 10th and August 18th, 1875. I had before quite often observed local depressions and upheavals of the chromosphere, sometimes extending over large surfaces, but I have never before observed such a *general* subsidence.

So thin was the chromosphere during this period that it was sometimes very difficult to obtain its spectrum by placing the slit of the spectroscope tangent to the limb of the sun. This was especially the case on the afternoon of August 9th.

This unusual thinness of the chromosphere could be easily recognized without the assistance of the spectroscope. Indeed, the phenomenon was even more interesting seen through the telescope, as, with it, the structure of the photosphere, lying as it does under the envelope of the chromosphere, could be better seen through the thin veil formed by the greatly attenuated chromospheric gases.

That the gases forming the chromosphere are sometimes thin enough to become transparent is a phenomenon which I have observed hundreds of times; as is abundantly proved by the numerous drawings of protuberances which I have made at the Harvard College Observatory, in which the limb of the sun is seen through the base of the protuberances in front of it.

During this period of general subsidence the granulations appeared to be smaller and farther apart than usual, and consequently the light-gray colored background upon which they are seen projected was more distinct, as it occupied more space than formerly. During this period, the light-giving element would appear to have been less than usual.

I am not aware that the phenomena of which I shall speak in this communication have been before observed; but I cannot speak positively on this point, owing perhaps to the somewhat confused nomenclature of solar physics.

Ever since I have observed the sun with instruments of a large aperture, I have noticed that the light-gray colored background seen between the granulations is by no means uniform, as it is generally stated to be. On the contrary it is greatly and strikingly diversified. Aside from the very small black dots called "pores," patches of a darker gray are irregularly distributed all over the surface of the sun. But partly owing to the effect of perspective, and partly on account of the thicker strata of the chromospheric gases through which they are necessarily seen near the limb, they disappear gradually as they approach the border.

These dark spots have been so remarkable during the present year, and so conspicuous during the period of the greatest subsidence of the chromosphere, that I have availed myself of every favorable opportunity to study them. So strongly were they marked that when one had passed the field of view it could be easily found again among many others, even after the lapse of several hours. Of the most striking and complicated I have made sketches.

In order to be able to count how many of these gray spots could be seen in different heliographic latitudes, and also to estimate their area with respect to the whole surface of the sun, Mr. W. A. Rogers, assistant at the Harvard College Observatory, kindly ruled for me on glass a reticule of small squares. Though the problem is apparently a simple one, it nevertheless presented many difficulties; partly owing to the minuteness and delicacy of these objects, partly on account of the unsteadiness of the atmosphere, and partly to the many defects caused by the great amount of heat concentrated at the focus of the objective. However, the observations show clearly that though the number of gray spots varies but very little in different latitudes, in general the spots become larger and more complicated as they approach the equatorial zones.

The most marked characteristic of the gray spots is their vagueness of outline. The are never sharply defined like ordinary spots, but they appear blurred and diffused like an object seen through a mist. As I shall endeavor to show presently, these objects are really seen through chromospheric gases which spread as a veil over them, causing this vagueness of outline. For this reason I propose for them the name of *Veiled Solar Spots.*

The veiled solar spots, especially in the lower latitudes, have a remarkable tendency to assemble into small groups after the manner of ordinary spots. Sometimes three or four are seen in contact, while there are comparatively large intervals where none are to be seen. I have in several instances seen the actual formation into groups of distinct veiled spots.

The granulations of the chromosphere are seen projected upon the veiled spots, just as anywhere else, but they are not there so regularly distributed; some being closely crowded together, while others are widely scattered. Small faculæ are often formed in this manner by the aggregation of several granules into one mass. Once in a while the granulations appear as if they were under the power of a propelling force by which they arrange themselves in files, and sometimes in capricious figures which are very remarkable.

In many cases I have observed that the granulations projected upon the veiled spots have an extraordinary mobility, to be seen nowhere else, except perhaps in the immediate vicinity of ordinary spots in full activity. Often their form and position are totally changed within a few minutes, and sometimes even within a few seconds. This was especially the case June 21st. At 8h. 30m. on that day I was observing a group of veiled spots not far from the centre of the sun, when my attention was drawn to the extraordinary mobility of the granulations covering this group. In an instant they changed their form and position, some crowding together as though briskly attracting each other, while others would fly apart as if repelled by an invisible force. Under this tumultuous conflict of forces, new veiled spots would appear and disappear in an instant, faculæ would form and vanish; in fact, all was in motion and confusion on that particular part of the sun. It was evident that immense forces were in contact under the chromosphere.

At 2h. 0m. P.M. on the same day several small black spots had opened through the chromosphere upon the group of veiled spots observed in the morning. At 8h. 0m. on the following morning the group of small black spots was considerably increased, having quite a large spot on the preceding side followed by twelve or fifteen smaller ones. On June 24th, this group had attained to its maximum size. It was then very large and complicated. In fact, it was the largest group of sun-spots observed thus far during the present year.

On August 8th, I noticed a group of veiled spots a little south of the sun's centre. The following morning at 7h. 0m. there was at the same place a small group of half a dozen black spots disposed in a crescent shape. At 2h. 0m. P.M. the black spots had vanished, but the veiled spots still remained, having retained the characteristic crescent form of the black spots and many other details observed in the morning; and, as a proof that the chromosphere covered this spot, *the granulations could be plainly seen upon the whole, indicating clearly that this spot was seen through the veil of the chromospheric gases.*

On August 24th, the same phenomenon took place. Just following the principal spot of the only group then to be seen on the surface of the sun, there was a fine group of veiled spots. The following day some black spots had made their appearance upon them. On August 27th, the black spots had vanished, but in their place the veiled spots seen at first still remained, and they continued to be seen there for several days.

To all appearances the black spots which I had seen disappear under the chromospheric gases, and which continued as veiled spots, were exactly alike and undistinguishable from the many other veiled spots scattered all over the sun; and, had I not seen the opening of the photosphere with the black spots, I could not have had any idea of the true nature of the veiled spots.

So far I have only spoken of veiled spots observed in the zones where the ordinary sun spots usually make their appearance; but, as I have said, the veiled spots are scattered all over the surface of the sun.

During this period I had many occasions to observe very remarkable and characteristic veiled spots in very high heliographic latitudes north and south. On July 15th, within a few degrees of the north pole of the sun, I observed a remarkable veiled spot unusually large and dark. Upon it were several bright slender faculæ projected in crest shape to very high altitudes. These faculæ appeared to be precisely like those observed in lower latitudes near ordinary sun spots. Upon this veiled spot could unmistakably be seen a small black spot, not a pore; a real opening of both chromosphere and photosphere.

On August 9th I observed another remarkable veiled spot within about 10° from the north pole, and upon it could be seen three small black spots.

On August 13th, at 11h. 0m., I observed a very dark veiled spot within 6° or 8° from the north pole. It had upon it a group of small faculæ so characteristic of the spots of lower latitudes. At 4h. 30m. in the afternoon this veiled spot was still darker, and upon it near a facula a pretty large black spot was visible.

On August 24th, I obseved a remarkable veiled spot at about 75° south latitude.

On September 6th, another large group of veiled spots was seen within 10° or 15° of the north pole. At 10h. 20m. some faculæ had formed upon it, and two black spots were distinctly visible. At 5h. 0m. in the afternoon this group was still visible.

On September 8th, within a few degrees of the north pole, I observed a fine group of two veiled spots, unusually dark and large, and near one of these spots there was a pretty large and bright facula. Ten minutes later the dark veiled spots had vanished, leaving in their place some bright faculæ. One minute later the veiled spots began to reappear, but under another form, to disappear again the next moment.

A little south-west from this last group, but in the same field of view, was another group of veiled spots apparently in full activity. Upon it three or four black spots were visible for some seconds. Upon these veiled spots the granulation had an extraordinary mobility; so much so that I expected at every moment to see a large spot make its appearance, but in less than a minute the veiled spots and the black spots had both vanished, and in their place were formed in an instant some very bright faculæ.

To all appearances, the veiled spots seen in high latitudes differ but very little from the ordinary sun spots of the lower latitudes, except in regard to magnitude and activity. The difference seems particularly to be that, in the first, the umbra, instead of being freed from the gases and vapors, is partly or wholly choked with them; while, besides, the chromosphere covers it. The forces which open the photosphere in high latitudes, it would seem, have not sufficient energy to repel or dissolve the chromospheric gases; or, if they have, it is in a very feeble degree, but, even then, the phenomenon is generally of short duration.

Though I had no means of making accurate measurements of the positions of the spots seen in high latitudes, the error of my estimation can not be very great. In any case a few degrees would certainly cover it, and it remains a fact that I have observed spots at least within 10° of the north pole of the sun. The importance of this observation will appear when it is stated that very few spots have been observed outside of the zones lying 40° on either side of the equator. I know of but two instances on record in which spots have been observed beyond this limit. La Hire observed a spot 70° from the equator, and more recently, in the month of June, 1846, Dr. C. H. F. Peters observed at Naples a spot 50° from the equator.

It is further to be remarked that according to the conclusions of the English observers, the solar spots attain higher latitudes during the years of the maximum number of spots, and recede more and more towards the equator as the minimum is approaching; and it is to be noted that the present year is precisely, or at least very nearly, a m. nimum year. It is doubtless owing to the unusual thinness of the chromosphere during this period that spots have been observed in so high latitudes this year. It is true that the spots were small but, nevertheless, they were genuine spots, with all the characteristics of larger spots.

It is difficult for one who has seen the phenomena which I have described to come to any other conclusion than this: that the veiled spots are breaks or true openings in the photosphere, seen through the imperfectly transparent gases composing the chromosphere, openings themselves partly or wholy filled by the vapors ejected by the forces from the interior of the photosphere. If this hypothesis should prove to be the expression of a fact, then we should expect to find that the photosphere is perforated by thousands of crevasses either partly or entirely filled with the vapors and gases from the interior, which can not be ejected outside for want of sufficient energy, save for a comparatively very small number situated in the equatorial zones, where this energy appears maximum, and is able to repel and dissolve the gases from the interior.

Before the observations of this year, I had arrived at precisely the same conclusions in regard to the opening of the photosphere in all latitudes, and to the existence of invisible spots concealed by the chromosphere. These conclusions were derived from my observations with the spectroscope, made at Harvard College Observatory during a period of thirty-five months. A discussion of these observations is reserved for a future communication.

Though one can hardly form a settled opinion with regard to the cause of the general depression of the chromosphere, on account of the imperfect data, it seems natural, however, to suppose that the phenomenon is connected in some way with the minimum periods of sun spots. Judging by the great number of veiled spots observed, and by the myriads of pores seen between the granulations, it would seem that both the chromosphere and photosphere have been much thinner than usual during the present year.

If there are breaks in the photosphere at many points of the surface of the sun, it becomes easy to account for the unusual thinness of the chromosphere this year, because as observed by myself and others, at certain phases of the spots, the chromospheric gases, rushing with impetuosity into the umbra, go down under the photosphere like gigantic waterfalls, diminishing consequently the thickness of the chromosphere. That this takes place I shall give ample proof in another communication.

It seems evident that the chromosphere near a spot is kept from falling into the opening by a force from the interior. As soon as this force decreases in energy, immediately the chromosphere tends to cover it, and even to precipitate itself through the opening when this force becomes extinct. The observations show this plainly.

When a spot is decreasing, it is quite common to observe that the umbra and penumbra appear as if they were seen through a heavy fall of snow, their surfaces being covered by numerous bright flocculent granulations surrounded by a kind of bluish fog. In a few instances of very rare definition, I have been surprised to see faint traces of this flocculent appearance upon almost all the spots; indeed it would seem that the spots are rarely free from some faint traces of the chromospheric gases. Probably the bright flocculent objects observed upon the umbra and penumbra of spots are the granulations of the chromosphere dissolved to a greater or less degree by the forces emanating from the spots.

Perhaps it may not be idle to remark that, during the period mentioned, I have almost every day observed small groups of faculæ in the polar regions, especially near the north pole of the sun; while, for the most part, they have been entirely absent from the equatorial regions, where they are commonly found.

To conclude, my observations show:

1. That during this year, and especially during the interval from June 10th to August 18th, and to a less degree to September 14th, the chromosphere has been notably thinner than usual upon the entire surface of the sun.
2. That the granulations have been smaller and less numerous.
3. That the light-gray colored background seen between the granules has been more conspicuous and has occupied more space than usual.
4. That there are spots, which I have named "veiled spots," which are seen through the chromosphere which is spread over them like a veil.
5. That these veiled spots are true openings of the photosphere, like those of the ordinary spots.
6. That during this period these spots have been larger, darker and more numerous than I have before seen them.
7. That the veiled spots are scattered throughout all latitudes, though more complicated in the regions where the ordinary spots make their appearance.
8. That I have observed spots at least within 10° of the north pole of the sun.
9. That the flocculent objects sometimes seen projected upon the umbra and penumbra of spots are the remaining portion of the granulations composing the chromosphere, more or less dissolved by the forces emanating from the interior of the photosphere.

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A NEW PYRHELIOMETER.

M. A. Crova has measured the calorific intensity of the solar radiation and its absorption by the atmosphere of the earth. With the pyrheliometer of Pouillet it appeared that the indications varied with the method of preparing the surface. If the silvered chamber containing the water is simply covered with one or more coatings of lampblack, a portion of the heat after passing through the coating is reflected by the metal and thence passes out through the lampblack which is diathermanous. The absorption is rendered more complete by employing an absorbing layer which is wholly metallic. A rough layer of copper is deposited galvanically on the box and on this a layer of platinum black. A large thermometer having a bulb 40mm. in diameter and a tube 300 mm. long replaces the ordinary silvered box. The bulb is covered with silver, copper, platinum, and finally with a thin coating of lampblack. The tube ends with a second bulb containing a little mercury, which may be introduced as an index into the tube. This thermometer is introduced into a hollow brass sphere polished without and blackened within, and having an aperture 30 mm. in diameter through which the sun's rays penetrate. The observation of the heating after numerous corrections gives with great delicacy the relative heat of the sun at different times.—*Comptes Rendus.*

ASTRONOMICAL DRAWINGS FOR THE CENTENNIAL.*

A unique feature of the Centennial Exhibition will be a series of thirty-six astronomical drawings of interesting celestial objects, executed in pastel by L. Trouvelot, the artist who produced the series of astronomical engravings undertaken by Professor Winlock at Harvard College Observatory. The pictures vary in size between eighteen by twenty-two inches and twenty-three and one half by twenty-eight and one half inches, exclusive of the frames. The following have been already completed, namely: Nebula in Orion, Nebula in Andromeda, Horseshoe Nebula, Winged Nebula, Trifid Nebula, Ring Nebula, Dumb-Bell Nebula, Cluster in Hercules, Coggia's Comet, the planets Mars, Jupiter, and Saturn, Sun-Spots in full activity, Solar Protuberance eruptive form, Solar Surface with Chromosphere, Protuberances and Corona, Aurora Borealis, Group of Sun-Spots with bridges, Milky Way in two parts, Zodiacal Light, Shower of Shooting Stars, and Temple's Nebula in the Pleiades. The original sketches have been for the most part made with an excellent refractor, of six and one-half inches aperture,

mounted in Mr. Trouvelot's Physical Observatory at Cambridge. Their production has been a work of immense labor. From fifteen to twenty-five nights have been spent in the study of each nebula. The sketch of Temple's Nebula in the Pleiades is the result of sixty-five hours' study. In the drawings of the Milky Way, the stars are plotted with considerable accuracy. Over a year was spent in the preparation of these two sketches. Of the sun-spots, protuberances, auroras, and zodiacal light, the most typical forms have been represented. In the shower of falling stars, every one represented was observed on the night of November 13th, 1869. It is Mr. Trouvelot's design to make these drawings available at the close of the Exhibition, in producing a series of astronomical charts for educational purposes.—*American Journal of Science and Arts.*

A BRILLIANT METEOR.

THE Boston *Transcript* says that a meteor of great brilliancy was seen in the south-eastern heavens on Saturday evening, February 5th, at 10.03, moving from east to south, and in a line the continuation of which would strike the horizon at an angle of about forty-five degrees. The moon was unobscured at the time, and the snow clad earth helped to make the earth almost as light as day; yet, notwithstanding this, the meteor gleamed forth with a splendor putting to utter shame all terrestrial pyrotechnics. A shaft of golden light was seen to shoot athwart the sky; after traversing a path which might have consumed a second in time, the erratic body relaxed its speed gradually, until it had become motionless; in an instant it burst into a shower of crimson and emerald brilliants, which descended in a luminous rain until they were extinguished.

VOLCANIC IRELAND.

THE area now occupied by the volcanic rocks in the north-eastern part of Ireland may be estimated at 2300 square miles, extending, moreover, to the west coast of Scotland. These last or Tertiary volcanic eruptions are some of the most extensive that the world has ever known, and it is to them that are to be referred the strange beauties of the Giants' Causeway and Fingal's Cave.

According to Prof. Hull, there are in the Lower Silurian, numerous examples of volcanic rocks in several parts of the island; thus in the counties of Wicklow and Waterford there are numerous sheets of felstones and porphyries accompanied by beds of ash and volcanic breccia, and similar conditions in other districts. All of these volcanic rocks are to be regarded as having been erupted from vents sporadically breaking out over the sea-bed of the period, they having been in turn covered up by fresh sediments. In the Upper Silurian there is little evidence of volcanic action; in the Devonian there are more, and in the Carboniferous they are still more decided. Coming down in the geological history, it is necessary to pass over to the Tertiary before the products of the volcanic fires are again met with.

"METEOROLOGY IN INDIA IN RELATION TO CHOLERA."

By Col. J. PUCKLE, M.S.C.

THE author in this paper lays before the Meteorological Society, London, some facts in connection with several serious outbreaks of cholera in different parts of the Mysore Country during the last fifteen years, and draws attention to the similarity of the abnormal meteorological conditions that existed on each occasion. Except in a few of the largest towns in India, there are no sewers, and no sewer-gas proper. Even in these exceptional towns the drainage is incomplete. The general sanitary arrangements are of the most primitive character. In the rural districts the inhabitants adhere to the Mosaic law in so far that they go forth to the fields, but they do not carry the "paddle" with them for the purpose that was the exponent of the "dry earth" system; *that* necessary portion of the work is left to the drying action of the powerful sun, to the kites and other carrion birds, and, *horribile dictu*, to the pigs and poultry that afterward are doubtless turned into food. In this way it is not difficult to conceive that sewage of the driest and most unadulterated kind may possibly be taken into the system through poisoned meat, or during rainfall it may find its way to open reservoirs or wells, on which two sources the inhabitants depend for their water supply. At other times during the hot, dry weather when no rain falls, malaria may arise and be distributed through the agency of the atmosphere. Notwithstanding all that has been said and done, the clue to the mystery of the origin of the disease remains undiscovered. It is the same with the treatment. Remedies that at one time appeared to be most effectual, have at another most singularly failed. Even during the same attack, the same remedy that cured one case would fail in another, even where the same conditions apparently existed. Failure of the usual rainfall at the proper time, and abnormally high and harsh temperature, have been concurrent with several attacks in Mysore and Southern India. At such times the open reservoirs or lakes and wells are much below the usual spring level, and any contamination received at such a time is obviously much less diluted and more harmful. The author then gives an account of several attacks that have come under his own personal knowledge, which show beyond doubt that the disease has been arrested by change of air and surroundings, and that ordinary sanitary practice has prevented a possible outbreak. After referring to the recent outbreaks at Bangalore and Madras, the author says that everywhere the same story is told of the occurrence of cholera coincident with long absence of rain and a temperature abnormally high.

INTERGLACIAL PERIODS.

TO THE EDITOR OF THE SCIENTIFIC AMERICAN:

In a recent article in the SCIENTIFIC AMERICAN SUPPLEMENT reasons are deduced in support of the theory that there must have been not alone one but several interglacial periods of high temperature alternating with the ice epochs. These reasons are predicated on accumulated geological discoveries; as, intercalated beds of stratified sand and gravel containing vegetable and animal remains, found in the boulder clay; and, especially, lignite beds, the growth of peat to form which would require a period, according to the estimate of Liebig, of 10,000 years,and a climate of far higher temperature than that of the glacial era.

Perhaps a reason for the idea of a single glacial epoch may be found in the immenseness of the time that has elapsed since the close of the latest; the mind tires in its backward journey when that is reached, and rests content. But the theory of alternate cold and warm periods of extremes, adequate to observed effects, though suggested and supported by, does not rest alone on, geological inferences; it is sustained by astronomical science.

The amount of heat derived from the sun for either hemisphere depends upon several diverse causes that coincide only at long intervals. The first of these refers to the constant change in the degree of eccentricity of the earth's orbit. The rate and periods of this change are according to known laws of motion, and have been carefully studied and computed by astronomers. At present that eccentricity is a trifle under .017, and is diminishing. By this the earth is brought, by a little over 3,000,000 miles, nearer the sun on the first of January, in each year, than on the first of July. Two hundred and ten thousand years ago, the degree of eccentricity was .0575, which was equivalent to 10,512,000 miles of difference between the earth's least and greatest distance from the sun in the course of the year.

The second cause is found in the inclination of the earth's equator to the plane of the ecliptic, whereby the sun's heat is projected, in greater or less proportions, upon the northern and southern hemispheres alternately.

The third is the combined effect of two unequal causes, always coincident in operation—the wheeling forward of the ellipse of the ecliptic (called change of the tine of apsides) and the precession of the equinoxes. This combined effect amounts to 61.9" per year; and, by that proportion of a great circle, changes each year the time of the earth coming to perihelion, or its nearest point to the sun. The period thus indicated, which is termed the revolution of the perihelion, is found to consist of about 20,937 tropical years; so that, at the expiration of half that period, 10,468 years from now, the earth will be nearest the sun in July instead of January, as it was 10,468 years ago.

Calculations show that for the long period from 300,000 B.C. to 100,000 B.C. the eccentricity of the earth's orbit was much greater than at present, varying from .0258 to .0569; so that the earth at aphelion increased its distance from the sun in an amount varying from 3,881,000 miles, to 6,724,000 miles greater than its present winter distance. And as the heat of the sun upon a given areas is inversely as the square of the distance (other things being equal), it follows that whenever, during the long period of greatest eccentricity, the earth was at aphelion, the heat was much less than at present; and whenever the several causes mentioned coincided—whenever, by the revolution of the perihelion, the earth attained its greatest proximity to the sun in the northern summer, and its greatest longinquity in winter, the annual extremes of heat and cold must have been excessive. During that 200,000 years the perihelion revolved nine times.

Taking 91,404,000 miles as the earth's mean distance from the sun, on or about the first of January its actual distance is, in round numbers, 89,881,000. This indicates an eccentricity of orbit of .01666; and under this degree of eccentricity our three winter months in Iowa averaged from 1839 to 1860, according to Prof. Parvin, a temperature of +23.37°, Fahrenheit. Pouillet, from his experiments, estimated that the heat of interplanetary space could not be greater than —142° Centigrade. Reduce this to Fahrenheit and add the +23.37° of Parvin, and we have 278.97° Fahrenheit as the effective winter heat power of the sun at its present winter distance.

If upon this, as a sort of *datum* line, we calculate the diminution of heat consequent upon the remotion of the earth to the distance attained during the period of maximum eccentricity, we have, as the sum of such diminution, 37.49°, Fahr., or —14.12°, as the average cold of an Iowa winter at that time. Of course this degree of cold increased towards the pole.

Dr. Kane, wintering within a degree of latitude of the great Greenland glacier, found the average temperature from October to April (latitude 78° 37′ N.), to be —23.43°; to this sum add the diminution as found above (37.49°), and we have 60.92° below zero as the average for six months of winter in the arctic regions during the glacial epochs.

Still another element enters into our calculation: the earth moves slower along that part of its orbit farthest from the sun, and faster along the part nearest. With the present eccentricity a difference of about eight days is made in the length of the seasons—from equinox to equinox respectively. Under the increased eccentricity mentioned this difference must have been more than three times as great; and the intensity of winter, at aphelion, was increased by its longer duration, while the ameliorating effects of summer were diminished by its briefness.

A long succession of these winters, at different epochs, covered the northern hemisphere deep in frost and snow; ice formed, increased, and moved southward, melting along its southern limits as it approached the tropics. Even the accumulated ice may have affected the earth's equilibrium, and submerged large areas of the hemisphere. These were the glacial epochs of the geologists. On the other hand, when the northern summer occurred at aphelion, its average heat was increased by its greater length, and it was followed by a winter milder and shorter than at present; and a succession, at different epochs, of several thousands of such years rescued the hemisphere up to the poles from the embrace of ice, elevated again the submerged tracts, and established the interglacial periods of the geologists. GEO. W. CHAPMAN.

Iowa Falls, Iowa, March, 8, 1876.

EFFECTS OF DISINFECTING SUBSTANCES ON THE LOWER ORGANISMS.

IN the last part issued of Cohn's *Beiträge zur Biologie der Pflanzen*, Dr. Schroeter gives the results of some experiments with various disinfectants in common use to observe their action on such organisms as *Bacterium Termo, Penicillium, Mucor*, etc. Some of these results may prove practically useful, though, as the author remarks, it does not follow that because certain disinfectants will kill the organisms named, they will also destroy contagious mater. But judging by analogy we are justified in the belief that such may be the case. Full proof of this position can only be obtained by experiment on the specific organisms of infection. There seems no doubt from the experiments of Drs. Schroeter, Cohn, and Eidam, that a lower temperature than that of boiling water is sufficient to kill *Bacterium Termo, Bacillus*, etc. Permanganate salts are only effective as very strong solutions. Thus *Bacteria* will live and propagate in a solution of permangate of potash, in the proportion of 1 part to 1000 of water. These salts the writer regards as quite unsuitable for disinfecting drains, though useful for dissipating vile odors and cleansing foul wounds. Fumigating with chlorine gas was only found effectual when moisture was present. Carbolic acid, either as a vapor or a solution, is regarded as a highly important disinfectant, inasmuch as an extremely diluted solution is sufficient to arrest the development of the lower organisms. For all practical purposes, Dr. Schroeter affirms this to be the best disinfectant in use, and thinks it not improbable that very weak doses of it may be administered internally with advantage.

Function of the Bladders of Aldrovanda and Utricularia.—Dr. Cohn, in the *Beiträge* quoted above, examines the question of the absorption and digestion of the nitrogenous substances of the insects and other organisms captured in the leaf-bladders of *Aldrovanda* and *Utricularia*. In general the opinion of continental biologists is averse to the theory that plants possess this power, and therefore the views of this distinguished naturalist will be read with considerable interest. Without fully committing himself either for or against the theory, Dr. Cohn adduces an argument in favor of the view that plants assimilate the nitrogenous substances thus brought within their reach, which we do not remember having been advanced by any previous observer. It is the total absence of roots in the genera he had under examination. With the exception of *Lemna arrhiza*, these are the only phanerogamus plants in which roots are absolutely wanting. On the other hand many of the plants supposed to be insectivorous are furnished with roots, so that the coincidence of the absence of roots and the presence of organs to entrap insects may be regarded as accidental. Dr. Cohn fully describes and figures the beautiful anatomy of the bladders of *Aldrovanda vesiculosa* and *Utricularia vulgaris*, and enumerates a great variety of insects, Rhizopods, Rotifers, Crustaceans, Infusoria, and other organisms found in them. Finally, he sums up favorably to the view that these plants at least do assimilate nitrogenous substances through their leaf-bladders.

On the Resistance offered by the Epidermal Structures to Evaporation.—Another article in Cohn's *Beiträge*, by Dr. Just, relates to this subject. The experiments instituted in elucidating this point were made upon pared and unpared apples. There were eleven sets of experiments, of ninety-six hours' duration, at different temperatures, ranging from 21° C. to 97° C. The most striking result was obtained from the experiment at the last-named temperature, the evaporation being almost equal from the pared and unpared apples. From the former it was at the rate of 73.67 grammes per square decimetre of the surface. At the lower temperature there was a difference of 41 grammes more from the pared apple during the same period. At 46° C. the pared apple attained its maximum amount of evaporation, and above this temperature it decreased with each increment of ten or twelve degrees of heat.

NEW VARNISH.

By M. ZINGLER, Belsize Park, Eng.

I DISSOLVE gum-copal or other hard gum heretofore used in varnish-making by means of a compound liquid. The compound liquid is composed of bisulphide of carbon one part, together with camphene or turpentine one part, benzole or rectified petroleum one part, and methylated spirit two parts, and to every one hundred pounds of gum, whether powdered or divided in small pieces, I add the same quantity (or more or less, according to the consistency of the required varnish) of the compound liquid, as described, and I put the mixture into a closed vessel in which a stirrer is provided, worked by some mechanical power, in order to work the gum with the said liquid.

The harder kinds of gum, such as Angola gum, animé, and Sierra Leone, I prefer to reduce to a fine powder before bringing them into contact with the compound liquid. In the case of the harder gums I prefer, also, to add a small quantity—say from ten to fifteen per cent—of tetrachloride of carbon before bringing them into contact with the solvent.

When the gum is thoroughly dissolved I place the solution in an open vessel, and let the liquid evaporate, either by air or slow heat, until I obtain a thick pasty-like gum, which resembles a thick elastic paste. This gum paste I put again into the vessel with the stirrer, into which I pour eupion; to every one hundred pounds of gum paste I add from one hundred to three hundred pounds of eupion, or more, according to the consistency of the varnish required.

Before using the ordinary commercial eupion I redistil the same, adding a small quantity of alkali—say, from three to five per cent of either soda or potassa. I prefer to use bicarbonate of soda.

When the gum paste is entirely dissolved I pour it into another vessel or closed tank and let it stand for a few days until it becomes clear, the dirt having settled to the bottom.

The dissolved gum paste, after it has become clear, can at once be used as a varnish, or, if it is required to enhance its spreading qualities, I add to it a small quantity of oleaginous matter, such as linseed-oil or castor-oil.

The varnish prepared as above described is a good preservative of wood and metal. It will not be affected either by moisture, cold, or heat, for the following reasons: first, that the gums I employ are not deteriorated by heat, they not having been fused nor acted on by any acid; second, I do not use any of the usual driers, which accelerate the oxidation of gums, and also attack metals; third, nor do I use any of the drying oils, which likewise oxidize, and are affected by the atmosphere if too dry or too cold.

NEW WHITE PAINT.

AN excellent white pigment is obtained by mixing a solution of the tungstate of soda with one of sulphate or chloride of zinc. Tungstate of zinc falls as a beautiful white percipitate, which requires merely washing with pure water by decantation and drying to be fit for use. It has a good covering power, and is not turned yellow by sulphuretted hydrogen. It will, therefore, be well suited for artistic and decorative purposes.

GOLD VARNISH.

A GOLD varnish for giving a beautiful gilding to brass and bronze objects is prepared from 16 grams of shellac, 4 grams of dragons' blood, 1 gram of turmeric root, and 332 grams of rectified spirits of wine. The varnish is thinly stroked over the surface with a sponge; the metal being warmed over a small coal-fire. The surface at first appears dull, but soon after it appears as if most beautifully gilded. The ready-prepared spirituous varnish must be preserved in well-closed vessels.

ARTIFICIAL WAX.

RESIN is melted with half its weight of paraffine or some other carbonized substance, at a temperature not exceeding 108° C. (230° Fahr.), when the resulting product closely resembles wax in composition; or the resin is melted with one third of tallow or stearic acid, and afterwards weakened by potash. Copal or vegetable wax may be added to the compound.—*Bulletin de la Société Chimique.*

[Popular Science Review.—Abstract.]

HOW MUSHROOMS ARE REPRODUCED.

(*Agaricus lacrymabundus. Fr.*)

By WORTHINGTON G. SMITH, F.L.S., M.A.I., F.R.HIST.S. IRELAND, ETC.

THE nature of the gills in various members of the mushroom tribe differs very much, and this difference is especially remarkable in the absence or presence of the trama, and in the number, form, and size of the cystidia. In the genus Coprinus there is no trama to the gills. The trama in true Agarics is formed by cells, which are of a different nature from the other simple cells which go to form the gills, and this trama forms the intermediate substance between the hymenial surfaces.

Nothing can be more different than the interior structure of the gills in the genus Coprinus, and in *Agaricus lacrymabundus* (Fr.). In Fig. 1 is shown, enlarged 150 diameters, a vertical transverse section down a gill of *C. radiatus* (Fr.), which species is (though minute) quite typical of the entire genus. The trama with its large cells would, if present, be at A; but a glance at the figure will show that the individual cells throughout this section are almost identical in size. If reference is now made to the similar section of a gill belonging to *A. lacrymabundus*, Fr. (and shown on Pl. *), the nature of the cells at A, which go to form the trama, will be quite apparent. Wide differences of cell-form like this are common in the mushroom tribe, but the difference of form as found amongst the cystidia is still more striking. In *Coprinus atramentarius* (Fr.) the cystidia are indeed so large that each individual cystidium would hold within itself more than 300 of the ordinary cells which go to build up the pileus. These facts regarding the cap and the hymenial surface (to say nothing of the gills often completely separating from the horny hymenophorum, as in Paxillus), and many other known facts in regard to the nature of the stem and its outer surface, go far to disprove the hypothesis that the higher fungi found under the Agaricini may be generalized as mere concreted masses of moulds. No bringing together into a mass of a forest of Penicellium could even make an Agaricus, and to me there is nothing in common between the conidio-spores of Penicellium and the basidiospores of the Agaricini.

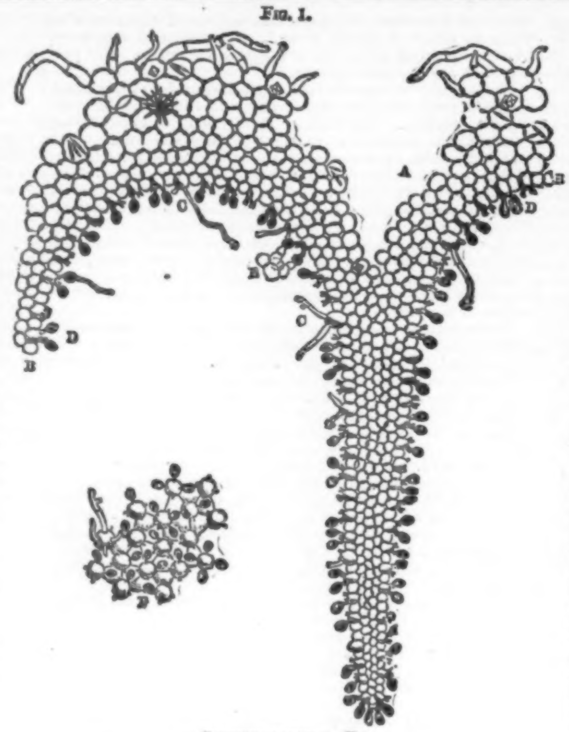
The various bodies which, as I believe, belong to the reproductive process in the mushroom tribe are seen in Figs. 1 and 2 and Pl.* The peculiar cells of the trama are shown at A, the simple cells which form the external and hymenial surface at B, and the privileged cells at C, D. C shows the cystidia and D the basidia. Each basidium in the Agaricini bears four minute spicules, which carry the same number of spores. The difference in size between the basidia and cystidia is often immense, and in *Agaricus lacrymabundus* the perfect forms of the two organs are very different from each other; they, however, so approach each other in this species that every intermediate form between a cystidium and a basidium may be observed. In *Coprinus radiatus*, as I have shown elsewhere, the cystidia have their contents differentiated, and at once produce spermatozoids; or they germinate, and the spermatozoids are produced from a differentiation which then takes place at the end of the thread; these spermatozoids attach themselves to and ultimately pierce the spores, and their piercing causes the discharge of a single cell from the pierced spore, which cell belongs to the pileus of the new plant. As I interpret my observations, this process is carried on upon the gills themselves, as shown in Fig. 1, and at the time of the perfect maturity of the fungus, at least in Coprinus, in the sub-genus Volvaria, in the ordinary mushroom, and in such plants as have fallen under my notice. The basidia with their spicules and spores, the cystidia germinating and bearing spermatozoids, and the first cells of a new plant (E) are all shown in position in Fig. 1.

Agaricus lacrymabundus (Fr.) is a very different plant from *Coprinus radiatus*. It is one of our commonest Agarics of the autumn, and is usually found in damp pastures and about stumps. It bears a considerable resemblance to the common mushroom, and is without doubt often gathered for the table in mistake for that species, but whether with any ill effects or not I am unable to say. The most striking character of this Agaric resides in its gills, which are always furnished with a white edge, which drips with semi-milky tear-like drops.

Part of a section of a specimen of *Agaricus lacrymabundus* is shown at E, Pl.* with the characteristic drops *in situ* on the gills and upper portion of stem, F G. The drops are shown towards the edge of a gill enlarged 100 diameters at H, above which may be seen several drops of a smaller size, which may or may not at length coalesce with the lower drop. These drops invariably dry up on the edges and surface of the gills. As far as I know, milky tears peculiar to *Agaricus lacrymabundus* have never been minutely described, neither has an account of any microscopical examination of them been hitherto published.

These drops are distilled direct from the cystidia. When the fungus reaches maturity the cystidia protrude boldly from the surface of the hymenium, as seen at C; and the apex of the cystidium opens exactly as does the ascus in Peziza. At first the cystidium is filled with a thin fluid in which no granules can be detected; but at length a large vacuole is formed at the base of the cystidium, and the contents are forced towards the apex: here the fluid becomes partly differentiated into granules, and at length the cystidium opens at the top and discharges its contents. The protruded drop now swarms with moving atoms of a regular size, which I refer to spermatozoids. They are in every way identical with the spermatozoids of *Coprinus radiatus* (Fr.).

FIG. 1.



COPRINUS COMATUS. Fr.
Vertical section and surface (F) of Gill enlarged 150 dia.

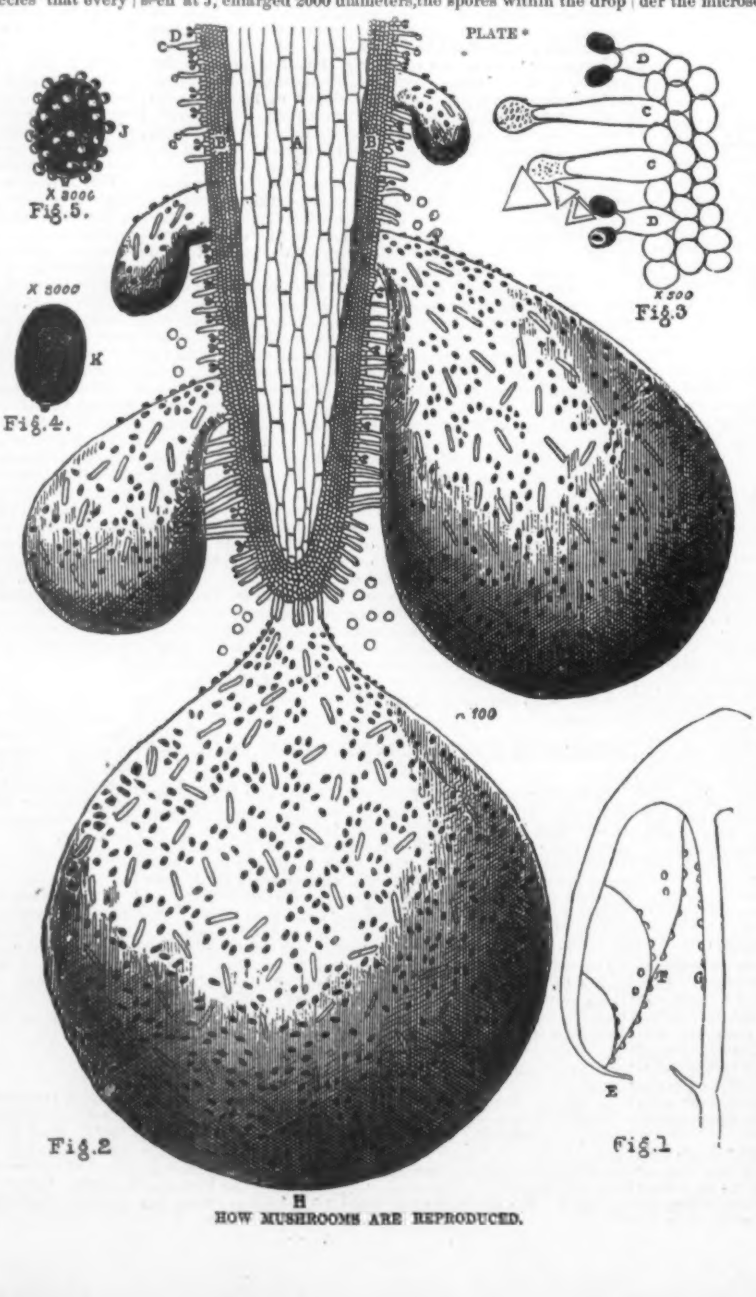
In my recent paper on the reproduction of *Coprinus radiatus* I adverted to the fact of the cystidia falling bodily away from the hymenium, and exactly the same phenomena holds good in *Agaricus lacrymabundus*; for if a drop of the liquid from the gills is examined under the microscope it will be seen to swarm with free cystidia which have dropped into the fluid from the gills; this liquid not only abounds with spermatozoid and cystidia, but it also swarms with spores which have fallen away from the basidia, as seen in Pl. *

If the spores which have fallen into the drop are examined, they will be found to be very different in aspect from the spores as they are seen upon the basidia; for whilst the spores in the latter position are perfectly plain in outline, as seen at J, enlarged 2000 diameters, the spores within the drop are studded all over the surface with the spermatozoids discharged from the cystidia. Not only are the spores studded as shown at K, but they are pierced through the external coat by a fine thread protruded from the spermatozoid. The effect of this is that a single free cell is soon after discharged from the spore, and this floats about in the drop, leaving the exospore quite empty. This single transparent cell, which is three or four times the size of the original spore, and is the first cell of the pileus of a new plant, is in its turn commonly attacked and pierced by the spermatozoids. Sometimes a spore is surrounded and pierced by a large number of spermatozoids, whilst at other times it receives the attack of one body only; this is, however, sufficient, for I have frequently seen the first cells discharged from the orifice made by a single spermatozoid, and the latter body again pushed out by the cell. The spermatozoids which have a single turn of a spiral revolve rapidly, and, when they come in contact with a spore, not unfrequently creep with an amœba-like movement over the surface, before they discharge their contents into the protoplasm of the spore. These bodies, as seen in *Coprinus radiatus*, are shown in the accompanying figure, enlarged to 1000 and 3000 diameters, and they are precisely the same in *Agaricus lacrymabundus*. When the spermatozoids of the latter species emerge they are dark brown in color, and here they resemble the spores; the at first colorless contents of basidia and cystidia alike become at first differentiated and then oxidized on exposure to the air. In a minute species like *Coprinus comatus*, where the growth of the plant is very rapid, and hundreds of generations are produced in one season, new plants are rapidly reproduced from the spores, and the growth can be watched; but in *Agaricus lacrymabundus* the case is very different, for it is probable that it would take many months (if not a whole year) to grow a perfect fungus belonging to this species from the spores. It must also be remembered that although this Agaric produces many millions of spores, yet the plant does not increase in actual numbers; for if all the spores produced plants, then in one year the world would be covered with this species only. For one spore which grows, hundreds of millions must be failures.

In a former paragraph reference was made to bodies intermediate in form between cystidia and basidia, and bodies of this nature are common on the upper part of the stem in *Agaricus lacrymabundus*; they are shown on the natural size section at G. The bodies in this position secrete and distil a semi-milky fluid, which they excrete in drops, which drops are invariably dotted all over the upper portion of the stem. It must not be thought that this distillation is peculiar to the species under notice, for it is a character (though till now unpublished) of whole sections of Agarics. For instance, certain groups coming under Tricholoma are described by Fries as "lamellis decolorantibus, rufomaculatus l. cinearscentibus." Now these brown spots on the gills, when examined under the microscope, are seen to be produced by a liquid which changes color, and which is distilled from the cystidia; and it is quite possible that the same phenomenon holds good in many other fungi, as in the tears of *Merulius lacrymans*, and in the drops found upon such species as *Polyporus dryadeus*, *P. hispidus*, *P. cuticularis*, and many others. It seems probable that in some species this liquid, which by a differentiation produces spermatozoids, also sends the spores into a temporary resting condition, and that the spores rest before germination, just in the same way as many seeds rest. This would explain the great difficulty of getting some fungus-spores to germinate. Under any circumstances diverse fungus spores resemble seeds in the fact of some germinating at once, whilst others will not germinate till long periods of time have elapsed.

On examining the semi-milky drops as seen on the stem, I have been unable to observe any production of spermatozoids, but these intermediate cystidium-like bodies are expelled from the stem and fall into the drops of moisture distilled. This is a state of things to be expected, for as these bodies belong to neither basidia nor cystidia, they are as a consequence quite as unable to produce spermatozoids as spicules and spores. In Agarics and Boleti the stem may be considered as a mere barren hymenium; when the stem is striate (as it commonly is) these striæ represent the absent gills; in species with decurrent gills, the fruiting surface (as in *Agaricus prunulus*) sometimes quite reaches the ground. When the stem in Boletus is reticulated, the reticulations represent the absent tubes, so that it should be a matter of no surprise to find organs pertaining to the hymenium upon the stem. The external surface of the pileus, for the same reason, often bears besidia and spores, and the stuffed stem and cartilaginous bark answers to the trama and hymenial surface. An Agaric or Boletus with the pileus and gills arrested would answer to a Clavaria bearing fruit all over the club, and abnormal Agarics are sometimes found in this condition, whilst the simplest form of *Hymenomycetes* is where a merely filmy hymenium is developed, as in Hymenula.

When it is remembered how innumerable are the myriads of spores and spermatozoids set free every autumn, and how probable it is that hybrids of every degree are produced from these bodies, the diverse and almost countless forms seen in the mushroom tribe quite cease to be a matter of wonder. Without doubt the spermatozoids of some species commonly pierce the spores of an ally, and so produce plants intermediate between one species and another; such forms are an every-day experience with fungologists and lichenologists, and the more one knows of species as species, the greater are the difficulties to be surmounted in correct naming. Fries himself says, under Mycena, that he has only given the best marked species, and that he knows in his mind many other apparently distinct



HOW MUSHROOMS ARE REPRODUCED.

forms and species which he has never published. Our cryptogamic floras require cutting down to at least one fourth of their present dimensions by some competent botanist, who is well acquainted with species. In the majority of instances the species are so ill-defined that it is the easiest possible matter to gather plants which it is simply impossible to refer to any described fungus, simply because the specimens gathered belong to none.

The spore, as found amongst Agarics, I consider female in the sense of its pertaining to the female in the same way as an unimpregnated ovum may be considered a female organ whilst still attached to the mother, and the spermatozoids male, as pertaining to the male in the same way as spermatozoids are always the direct offspring of the male (as ova are of the female). When the spore is pierced by the spermatozoid, the former is capable on germination of producing either or both sexes. If these views are correct, a term is required for the unpierced spore synonymous with the ovule in flowering plants, as distinguished from the seed; and the old term sporule might well be used for indicating the unpierced spore. The spores in *Agarics* must be considered very different in nature from gemmæ, or buds, and they are totally different from the conidia or conidio-spores of Penicilluas and the acro-spores of Mucor. The latter may reasonably be compared with the bulbils of Dentaria, and some Liliaceæ; but the nature of the basidio-spores (and of the hymenium which carries them) points to a very different conclusion. It is a very common thing for the mycelial threads of all sorts of fungi to break up into bead-like conidia, and as these conidia or secondary spores have a certain reproductive power, there is here certainly a slight analogy with gemmæ. The spores and spermatozoids in the Agaracini appear to me to have a strong analogy with the oosphere and spermatozoids of *Fucus vesiculosus*, the cystidia having an analogy with the antheridium in the same Alga. I have expressed an opinion elsewhere that Van Tieghem's idea of male and female spores in the Agaricini is altogether untenable; such a thing as a male ovum or spore is as unreasonable as a female spermatozoid or female pollen-grain. Seeds of all sorts are capable, on germination, of producing either or both sexes, though it is common enough to see one sex exalted at the expense of another. Even in the highest mammals the males have a trace of the female in the subordinate mammæ and other characters, and similar characters which show a trace of the male are found in most female animals.

In the vegetable kingdom nothing is more common than to find so-called male or female plants changing their characters. Males will, under altered conditions, carry female organs, and females will produce anthers and pollen, which conclusively shows that not only are ovules, spores, seeds, and eggs not in themselves male or female, but the produce itself of these eggs is inherently hermaphrodite. It is convenient to name many animals and plants "male" and "female," because they are almost but not entirely so.

Several papers have been published of late on the reproductive process in the *Basidiomycetes*, and the writers of these papers have noted (with me) the diverse mycelia seen amongst the germinating spores; but I am convinced that the threads which produced antherozoids, as seen by Van Tieghem, came from the cystidia and not the spores. When a mass of spores and threads are seen in a solution of horse-dung, nothing is more difficult than to decide for certain whether the threads really come from the spores or not, and the spores of *Coprinus radiatus* could not possibly have been "sown" on any decoction without cystidia likewise falling upon the liquid. The "rod-like" bodies described by Van Tieghem read remarkably like an illustration of the well-known fact of the threads of many fungi breaking up into Bacteria at the tips. In the many Agarics I have examined, it invariably happens with me that after a spore is pierced it discharges a single cell, which develops directly into a new individual, exactly as is seen in Chara, but an unpierced spore may produce a thread of indefinite length; now if this thread is attacked by the spermatozoids, it will in its turn produce this single primordial cell of a new fungus, or if the mere undifferentiated liquid contents of the cystidium should pass over the thread from an unpierced spore, it there gives rise (at the point of contact) to the primordial cells.

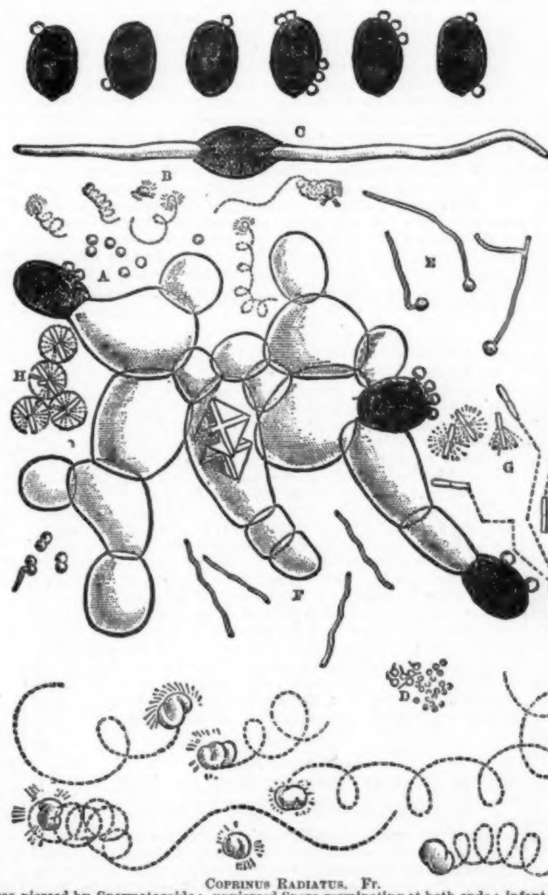
The persistence of form in spores, and especially the pierced spores, under extraordinary conditions, is something remarkable; for instance, repeated violent boiling has no effec on the form and color of the spore, and in the cases where the spermatozoids are attached no amount of boiling disengages them; if any thing, the boiling seems to make the piercing more distinct to the eye. I do not find conidia or gemmæ resist boiling in this manner, and certainly no bulbil or bud from a flowering plant would maintain its form under these conditions. As for the unpierced spores, I believe their life to be of the very shortest duration (not twenty-four hours), but after piercing the life remains, just as we find life slight in an ovule but enduring in a seed.

As dung swarms with fungi and infusoria of all sorts, the greatest care is necessary in experiments, or Bacteria will be mistaken for Spermatia, and Sphærobacteria for Spermatozoids. To clear up some little of the confusion which might arise as to all these bodies, the infusoria are engraved in Fig. 2 to the same scale as the spores and bodies referred by me to spermatozoids; A shows the globular spermatozoids as they are at first produced within the cystidium, or within the end of a thread more or less long, protruded from a cystidium: these bodies are at first motionless, but after being kept in liquid for a few hours they begin to slowly revolve; this movement keeps on for several days, and is all the time accelerated, whilst the body (formerly spherical) now becomes slightly elongated, and a single turn of a spiral is seen as in the larger figures shown at the bottom of the plate; the dotted lines indicate the whirling motion of the spermatozoids. For comparison with this, various tailed and tailless monads are engraved at D, which figures may be compared with the spermatozoids to the same scale on the upper part of the plate. These latter bodies have been long known, and Mr. Berkeley, in the "Micrographic Dictionary" (last edition), p. 20, says: "The bodies called cystidia or pollinaria are globular or oval cells, found associated with the basidia, containing granular matter, exhibiting molecular motion when discharged." In common with many other botanists, I am inclined to think this movement to be other than molecular, as the eddy clearly seen round the revolving bodies indicates the presence of cilia. It is impossible to believe that *life* can spring from *no-life*, the mere molecular movement of lifeless particles must be of a totally different nature from the life-movements of spermatozoids and infusoria. The revolving bodies might be referred to Micrococcus, one of the Sphærobacteria, but it must be remembered that they are the differentiated contents of the cystidia. It may be answered that if the mycelial threads of fungi will break up into true Bacteria, why may not the cell contents reappear as one of the Sphærobacteria? The question then arises, What is the nature of the obscure bodies referred to Bacteria? Are Dr. Eidam's spermatia no other than Bacteria? they are sufficiently like Bacteria. Are certain so-called Bacteria and antherozoids of some cryptograms one and the same? When once produced they are both very persistent, and they are both produced under somewhat similar conditions. The spermatozoids of Agarics only appear as the fungus has just passed maturity, and as decomposition is setting in; and as soon as the spermatozoids are set free, then the material from which they spring has vanished.

It is just worthy of note that certain spermatozoids and bacteria resemble each other in size and external form, that they are alike in being furnished with flagella or cilia, that they are produced at a time when decomposition is just setting in, and that they are seen in semi-milky fluids. The spherical bodies when they become attached to the spores, or even threads, rupture at one end and discharge a fine thread, as at E, where they are shown germinating in a free state, which is no uncommon occurrence. Vibriones are shown at F, Fig. 2; these bodies, with the bacteria, show at G and H, are well known to all microscopists, and it has appeared to me that they are mere differentiated states of the old cells of the fungus which have broken up and (as a collection of cells) totally disappeared. The dotted lines indicate the movements of the bodies, whether straight, zigzag, or revolving like a wheel.

Whether the fertilized spores are able to withstand great vicissitudes of temperature and still not lose their vitality is unknown, but if other living atoms are able to live in boiling fluids, or be frozen and still live, it should be a matter of no surprise to find fungus spores passing unscathed through similar ordeals. It is reasonable enough to imagine life to be maintained under extraordinary conditions, but to me most unreasonable to imagine life to spring from that which is without life.

FIG. 2



COPRINUS RADIATUS. Fr.
Spores pierced by Spermatozoids; unpierced Spore germinating at both ends; infant plant and infusoria enlarged 1000 diameters; Spermatozoids at bottom of plate further enlarged 3000 diameters.

As the cells of decomposing fungi disappear, various infusoria at the same time swarm into being and take the place of the collapsed cells. On violently boiling these infusoria in test-tubes along with fragments of putrid fungi, for five minutes, and sealing at the highest point of ebullition, I find the infusoria, after one or two or three months, to be still alive. During this time putrefaction is arrested in the test-tubes, the decayed fragments of fungi remain the same, and the infusoria remain inert. On opening the flasks the infusoria are at first motionless, and life is apparently at a low ebb, but the individual infusoria, as watched under the microscope, rapidly regain their accustomed activity, and in a few hours are as full of life as if they had never been boiled. The decomposing fragments of fungi now rapidly give the fluid an offensive odor.

Whilst able to resist the heat of boiling-point, these same infusoria are equally well able to resist cold, for during the frosts of the past month I froze decoctions of fungi containing infusoria into solid blocks of ice for a whole week. On thawing after this time the bacteria, vibriones, monads, etc. were as full of life as before freezing.

EXPLANATION OF PLATE.* (preceding page.)

FIG. 1. Vertical section through gills and stem of Agaricus (*Hypholoma*) lacrymabundus (Fr.). E, Veil. F, drops on gill. G, drops on upper part of stem, natural size.

FIG. 2. Vertical transverse section through edge of gill, with drops *in situ*. Enlarged 100 diameters. A, Trama. B, Cells forming Hymenium. C, Cystidium. D, Basidium. H, lowermost drop, containing cystidia and spores.

FIG. 3. Cells of Hymenium. C, Cystidia, containing spermatozoids. D, Basidia, with spores attached, and tringular flat crystals from the juices of the plant. Enlarged 500 diameters.

FIG. 4. Spore unpierced by spermatozoids, enlarged 3000 diameters.

FIG. 5. Spore pierced by spermatozoids, from a drop which had dried on the surface of the Hymenium. Enlarged 3000 diameters.

[Journal of the Society of Arts.]

IMPORTATION OF FRESH MEAT FROM AMERICA IN REFRIGERATED CHAMBERS.

ATTENTION having very recently been called in these columns to the various methods projected and experimented on for bringing meat to this country by the aid of refrigeration, it is not necessary to recapitulate them. Though some have been partially successful when tried on a small scale, it is unhappily a fact that, till within the last few months, or it might be said weeks, no method has been practically adopted in the way of a commercial enterprise likely to appreciably augment our meat supply and affect our home market. The cost of producing and maintaining by ice itself, or by some chemical process, a sufficiently low temperature for the transportation of fresh meat to this country, has been the main obstacle in the way of a realization of the much desired end; and it will, therefore, be interesting to put on record some account of a recent attempt to supply our Metropolitan meat-market with fresh meat from America, by aid of the means alluded to.

It was in October last that the experiment was first made, and this having proved successful, it has been followed up with a succession of importations since Christmas, the total weight imported having reached as much as 400 tons, and it is stated that the consignment which arrived last week exceeded all previous ones. The meat hitherto received, consisting chiefly of beef, has been shipped in steamers at New-York, landed at Liverpool, and forwarded to the Metropolitan Meat-market by train, where it has been openly sold, and in as good condition as that in which it left New-York. Of course there is nothing new in meat being kept in a temporary state of preservation by means of refrigeration. At the International Exhibition at South Kensington, in 1873, when a variety of refrigerators or ice-safes were exhibited in the Food Section, Mr. Kent, of High Holborn, exhibited a ventilated ice-safe constructed on this principle. A large number of the leading butchers in London and the provinces have had chambers constructed on this principle in their establishments, and found them to answer admirably; at the Alexandra Palace the refreshment contractors keep tons of miscellaneous provisions in such a chamber during the hottest weather; several first-class ocean steamers, the *Walmer Castle* and *Windsor Castle* for instance, have been furnished with them, so that passengers and crew can depend on a supply of fresh meat for more than two months; while the principle has been adopted at the House of Commons, and the draught of air over tons of ice keeps the house at a comfortably low temperature during the dog-days. But this "draught" principle of refrigeration has not been yet applied in reference to the transport of fresh meat from foreign countries, unless, indeed, the patented system by which the recent importations of meat have been effected is more or less an adaptation of it, thereby affording another instance of an American borrowing English ideas and getting the credit of originality.

The result of the experimental importations has been reported as satisfactory as far as the condition of the meat is concerned. The quarters of beef, being tightly stitched up in canvas and suspended in a chamber on board ship, are constantly surrounded by a temperature of about 37 degrees, this atmosphere being kept in constant motion by the action of a fan worked over the ice-tanks by steam. Hence the meat is kept not only cool but dry, in fact so much drier than ordinary meat that it is not in the least affected by its transit from Liverpool to London. But, according to the old adage, the best proof of the pudding is in the eating. The imported American beef has been intrusted to several salesmen in the Metropolitan Market by Mr. J. D. Link, also of the Metropolitan Market, and sole agent of the American consignors, and the salesmen have made no secret of the matter at all, but sold it for what it was, and at a price but a few pence per stone below that realized by good Scotch and English meat. Those who have tasted it in a critical spirit, and among them may be mentioned the Lord Mayor and other civic authorities, have declared it to be in no way inferior to sound Norfolk beef or even "prime Scot."

What will be the future of this experiment, the extent of its development, and its effect on our markets, are interesting questions. It is said that it has already caused a fall in Scotch meat of 1*d*. per lb., though the foreign meat imported is, comparatively speaking, inappreciable in quantity. But the consignors, it is stated, are ready to send over 500 tons per week "if the market will bear it." If this were carried out, prices "all round" must be affected, but with them the price of the imported meat itself. And then what will happen? The question is asked, because the price of meat in New-York does not differ substantially from the price here. Perhaps the success of the experiment will lead to its being tried in reference to meat obtained in some cheap locality, and shipped at other ports than New-York, and thus the cost of present carriage, or of driving the cattle from Western districts to New-York, would be saved. But, then, arises the question of a longer voyage, increased consumption of ice, and so increased cost in these particulars. Again, the recent experiments have been made mainly in the winter months. How will the system work in the summer months? There will be a greater consumption of ice, of course, and not so much to sell of that unconsumed on the voyage as has been sold in Liverpool during the winter months. And further, the transport of the meat from Liverpool to London by railway will be a hazardous thing in the summer, unless refrigerating and ventilated wagons are used—and this would, of course, add to the expenses.

It is probable that the Food Committee of the Society will shortly make a trial of some of the American meat, and report upon the result.

THE Academy of Medicine and Surgery, St. Petersburg, is attended by 171 women and girls, 102 of whom are of titled birth. They mix harmoniously with the other sex in the dissecting-room.

[Medical Record.]

MEDICAL USES OF GALVANISM.

ABSTRACT FROM A CLINICAL LECTURE DELIVERED FEB. 7, 1876,

BY PROF. HENRY G. PIFFARD, M.D., UNIVERSITY OF THE CITY OF NEW YORK.

(*Reported by Dr. Geo. H. Fox.*)

GALVANISM may be used in five different ways in the treatment of disease, and with results varying with the manner of application. In two of these the galvanism is employed indirectly, in three directly. In the former it does not enter into or modify the tissues, but induces other phenomena which are then employed remedially. In the latter it does enter the body and directly affects the parts. These applications are:

1. To excite an induced electrical current in a coil of wire surrounding a temporary magnet (*indirect*).
2. To produce *catalysis* (*direct*).
3. To produce *electrolysis* (*direct*).
4. To produce *coagulation* (*direct*).
5. To produce an intense heat in a small piece of platinum or other metal (*indirect*).

The nature and effects of the induced electrical current have already been fully explained by one of your other teachers, and need not detain us at present. The other four applications of galvanism I shall allude to but briefly, and simply to explain them, in order that you may obtain a clear idea of the fundamental principles which underlie the employment of this agent, and the kinds of phenomena which it is capable of producing.

By *catalysis* we mean a modification of nutrition. If the current from a galvanic battery, composed of a number of cells properly joined, be passed through the body by means of moistened sponge-covered rheophones applied to the surface, we may in one instance, by stimulating the nervous system or the circulation, exalt the vitality of parts in which it is depressed; in another instance we may subdue pain; in a third, remove pruritus; in a fourth, hasten the resolution of an inflammation; in a fifth, reduce an infiltration; and in a sixth, cause the partial or total disappearance of a tumor. These are all effected by modifications of the local nutritive processes, whereby absorption is rendered more active, and normal action supplants the pathological.

By *electrolysis*, on the other hand, we mean the direct decomposition and destruction of tissue elements, and of the fluids which surround them. The simplest illustration of the electrolytic effects of the galvanic current is the decomposition of saline solutions. If, for instance, the current be passed through a solution of iodide of potassium, this compound, as well as the water, is split up into its component elements. By looking at the screen (a magic lantern was arranged with a glass cell containing a dilute solution of potass. iod. at its focus; into this were introduced wires connected with the poles of a battery) you will see, the moment the current passes through the fluid, an active change occurring in the solution. At one wire we see a brownish discoloration, at the other the development of numerous bubbles. Oxygen, acids, and similar bodies collect in the neighborhood of the positive pole; hydrogen, alkalies, and basic substances at the negative. In this instance the oxygen, resulting from the decomposition of the water collecting at the positive pole, rapidly oxidizes the metal of which the wire is composed; the free iodine, also collecting at this point, discolors the solution in the neighborhood. At the other pole the potassium is free, but, being readily soluble, is unperceived; while the hydrogen, unable to combine with the wire, escapes in the form of little bubbles. If now, instead of dipping the wires into a saline solution, they are plunged directly into the body, the same phenomena will occur, and the tissues and fluids in their immediate neighborhood will in like manner be split up into their elements or into simpler compounds. As the tissues, however, are very complex in their composition, additional phenomena occur. These are, first, an appreciable elevation of temperature in the wires, which effects a slight cauterizing action upon the parts; and second, at one of the poles a slight tendency to the coagulation of albuminous and fibrinous substances. This latter effect is readily demonstrated. If you again look at the screen (the cell containing the potash solution was replaced by one containing albumen, and the wires adjusted as before) you will see, when the circuit is closed, that bubbles of hydrogen appear at the negative wire, but at the same time the positive wire is becoming surrounded by a dense mass of opaque material, which in this instance is coagulated albumen. From this we see that *electrolysis* is most active at the negative, and *coagulation* at the positive pole. Electrolysis enables us to destroy morbid growths, and coagulation enables us to occlude vessels by the formation of clots.

The last (*indirect*) application of galvanism is what is known as the galvano-cautery. If a strong galvanic current passes readily through the wire which connects its poles, it does so without creating much disturbance; but if its passage is resisted, heat is developed at the point of resistance. Platinum is a resisting body, and if a small piece of it be introduced into the circuit, it soon becomes red and then white hot (this was demonstrated with a small cautery battery). This heated platinum may then be used as a counter-irritant, as a hæmostatic, or for the destruction or removal of morbid growths. The other day you were shown a tumor which I had removed in this manner. I will now show you a photograph of the patient before the operation (the photograph was projected upon the screen about twice the size of life; it displayed a hypertrophied *preputium clitoridis*, which after removal weighed 6¾ ounces).

THERMAL EQUIVALENT OF MAGNETISM.

M. A. CAZIN has published in full a series of experiments on the relations of heat and magnetism. In the first portion of the memoir three methods are described of measuring the relative values of the heat created by the disappearance of magnetism, in the core of an electro-magnet. The second section demonstrates several laws of the magnetic heat developed, and shows that this heat is really due to the disappearance of the magnetism. But in the induction of the core on the coil, and of the coil on itself, causes of heat are found which should be allowed for. The fundamental law deduced from these experiments is, that the disappearance of magnetism in the core of a bar electro-magnet having two poles is accompanied by the creation of a quantity of heat Q proportional to the polar interval l, and to the square of the quantity of temporary magnetism m which the core acquires when the circuit is closed. The product m^2l is a magnitude of the same kind as the quantity of heat Q, and may be called the magnetic energy. The ratio $\frac{m^2l}{Q}$ will be the mechanical equivalent of heat. In the third section the value of Q is determined in units of heat while the effects of induction are inconsiderable. The first series gave as a mean of five experiments while the spark was broken in all 110600000, as the magnetic equivalent. A second more reliable series with the spark broken in ether gave 106000000. Both are a little too great because the induced current on breaking the circuit is not zero. Hence probably the true value does not differ materially from 100000000.—*Ann. Chim. et Phys.*

OUTLET OF THE GREAT SALT LAKE.

WHEN the water of Great Salt Lake was at its maximum altitude it carved and moulded a beach, which yet remains—a conspicuous monument to its former greatness. Within the circle of this beach-line are included also Utah and Sevier lakes. The level of the ancient beach is 970 feet higher than Great Salt Lake, about 700 feet higher than Utah Lake, and about 550 feet higher than Sevier Lake. From the upper beach the water slowly subsided by desiccation, recording its lingerings in a series of fainter shore-lines. When it had fallen to the level of the divide between the Sevier and Salt Lake basins, it was separated into two unequal portions. In one of these the evaporation exceeded the inflow from rivers, and the subsidence continued; in the other the inflow exceeded the evaporation, and the surplus was discharged over the divide into the former portion, just as the surplus of Utah Lake is now discharged into Great Salt Lake. In the course of time as the climate became drier, this overflow ceased; but not until it had carved a channel of some magnitude.—*American Journal of Science and Arts.*

FRESH-WATER SHELL MOUNDS OF THE ST. JOHN'S RIVER, FLORIDA.

THE mounds are often five or six hundred feet in length, and vary from a few feet to eighteen or twenty in height. Dr. Wyman states as his conclusions that at the least two or three hundred years, and probably more, have passed since they were finished; that the fact that the human bones are broken in the same manner as the bones of edible animals proves the makers to have probably been cannibals; that fragments of pottery, while common in the later mounds, are not found in the older; that stone implements are few in the older mounds and rudely made; that the shell heaps contain fragments of the Mastodon, Elephant, Horse, Ox, and some other extinct animals, but that these show by the changes they have undergone that the animals were not cotemporaries of the mound-builders; that the only skull found differs from the skulls of the Indian burial-mounds of the country in being longer, with the ridges and processes more pronounced, and that among the bones of two other individuals the tibia was flattened; that, while it is uncertain whether the makers of the mounds were the same people that were found there by the Spaniards and French, the absence of pipes and pottery, and the rarity of ornaments, are consistent with the conclusion that they were a different people. —*American Journal of Science and Arts.*

SULPHUR AS A FIRE-EXTINGUISHER.

M. CHARLES TELLIER has addressed a suggestion to the French Academy for the ready extinction of fires on board ship. As they generally break out in the hold, that is to say in a confined space, it is possible to extinguish them by means indicated both by science and practice. The most simple of these agents is sulphur, which, introduced into the hold and ignited, rapidly generates sulphuric acid, the extinguishing properties of which are well known. There is no hesitation in making use of sulphur in the case of a chimney catching fire, and every captain would take a sufficient quantity on board. For easy application, matches should be made of sulphur, to be ignited and introduced when occasion required, in holes made for the purpose in each deck. Wet sails placed over the hatches would permit of the air in the hold expanding, and would also prevent the entrance of the outer air. The sulphurous acid, on account of its density, would find its way into every corner, and when the fire was extinguished, a thorough ventilation would drive out the gas. A sufficient quantity of sulphur only would be required to absorb half the oxygen of the air, inasmuch as air deprived of half its oxygen will no longer support combustion.

[Bee-Keepers' Magazine.]

SIXTH ANNUAL CONVENTION OF THE NORTH-EASTERN BEE-KEEPERS' ASSOCIATION.

THE North-eastern Bee-Keeper's Association was organized to promote the scientific culture of bees, by means of the mutual interchange of views and by co-operative experimental investigation. Its members consist of prominent apiarians in New-England and New-York.

Acording to announcement, the society met at Stanwix Hall, Rome, N. Y., February 2d, 1876. The meeting was called to order by the president, Captain J. E. Hetherington, of Cherry Valley. The president paid an eloquent tribute to the memory of Moses Quinby, of St. John'sville, whose labors in the promotion of advanced agriculture, and especially in the field of bee-culture, made him famous. He further criticised the practice of exaggerating the profits of this business and ignoring the failures and unprofitable seasons. Four out of five who enter the business fail because they are not adapted to it. The chief need now is a greater knowledge of wintering, and scientific observation.

Balloting then progressed, with the following results: President, Ruben Bacon, of Verona, N. Y.; Secretary, J. H. Nellis, of Canajoharie; Treasurer, L. C. Root, of Mohawk.

Various questions were presented and a "Question Drawer" was proposed. A committee were chosen to answer the questions presented, with the understanding that upon difference of opinion existing among members of the association the questions might be discussed. The question of whether it is profitable to insert extra uncapped honey in the comb, in the centre of the hive, to incite breeding was raised. There was a difference of opinion. Some favored the insertion of clean extra comb, as it is easy to see whether the empty comb is for the use of the queen, which is not the case with comb containing honey. Besides, it requires time for the bees to remove honey from the comb, and it requires time to insert the comb and is an interruption to the operations of the queen. No one favored wholesale feeding, and few favored feeding at all for the purpose of stimulating brood-raising.

Capt. Hetherington would feed rye meal in the spring, before pollen appears, for the purpose of inducing breeding. Use rye-flour, with sawdust to prevent their smothering in it. Such feed should not be placed far away, as it is desirable to keep the bees near the hive until all fear of cold weather is passed.

Mr. Betsinger thought that to feed any thing before the 1st or 10th of May is a disadvantage, as it induces bees to stray away and perish. He is never troubled for want of pollen. He would like to exchange it for empty comb. He loses wax in geting rid of it. But in some localities pollen does not seem to be so plenty. Mr. Betsinger would give $10 for some plan for successfully extracting pollen.

Mr. Doolittle found that the excess of pollen comes from hard-maple and wild-grape blossoms. As white clover is not plenty in his locality, the bees make honey very slowly from it, so that they stain the comb by running over it. Where clover is plenty, no such trouble is experienced. He considers the bass-wood the great honey-producer. It remains in blossom from three to twenty-one days. It is the honey-tree, a cluster of blossoms sometimes containing one or two drops of visible honey.

Capt. Hetherington and Mr. Scofield expressed the opinion that cool nights are unfavorable to the development of honey in blossoms. Hence last season was a bad one. They notice that they get a good yield of clover-honey when the clover seeds well, and of buckwheat-honey when the farmers have a good crop.

HOW FAR DO BEES TRAVEL?

Mr. Betsinger wanted to know how far bees will go to gather honey. It is proved positively that they go two miles. In case of scarcity, Capt. Hetherington said they might go farther. He counts on their working over an area of a mile and a half radius, and locates his apiaries accordingly. Mr. Doolittle is sure they go of choice four or five miles, and gave facts that seemed to substantiate the idea.

Mr. Scofield was of the opinion that his bees travel much farther west than in any other direction—probably because they catch the odors from this direction better.

Mr. Betsinger has noticed the field of operation of his bees, and is satisfied that they go at least seven miles away from home, and travel as fast as a mile in two minutes. Mr. Doolittle confirmed this statement, his Italian bees being seen and lined from three miles beyond Skaneateles Lake, which is two miles wide and two miles south-west of his residence, a distance of seven miles.

Mr. Doolittle and Mr. Betsinger allow the bees to raise all the brood they will, claiming that while the hive is filled with brood the bees will fill boxes, and the more brood hatches the more workers there are, and the more boxes filled. As fall approaches brood decreases, and the comb is filled with honey for the winter use of the bees. Thus these gentlemen get all the earliest and best honey in their boxes, and the bees are left to feed on the latest made and the darkest honey. By this practice, these apiculturists have been eminently successful. They use small frames, 10¾ x 10¼, inside measure, 8 or 9 in number.

Mr. Doolittle thought that more bees perish from going out in the spring and gorging themselves with cold water, thus chilling themselves, than from any sudden falling of the temperature of the atmosphere. They require water for the purpose of brood-rearing, and it should be supplied them, with the chill off, near the hive.

Capt. Hetherington was of the opinion that the appliances and improved system of management now in practice among advanced apiarists secure three times as large a yield of honey as could be obtained six years ago by the system then in general operation. He thought that from a judicious system of non-swarming the best results are obtained, as the whole force of the colony is then engaged in the production of surplus honey. But in case the swarming-fever gets possession of a stock, it must be broken up at once. This is best done by humoring them. In general management, to allow a moderate increase is much better than to undertake to suppress the swarming fever altogether.

At request of members of the meeting, Mr. C. R. Isham, of Peoria, N. Y., exhibited his new glass honey-box, which was well received by the most experienced, and universally admired. It is thought this box will reolutionize the style of surplus honey packages.

The student who shall discover an unfailing method of keeping bees during their dormant period will be a public benefactor.

QUESTIONS AND ANSWERS.

The contents of the Question Drawer were then read. The answers to the queries presented were prepared by a committee of three practical bee-keepers.

1. What is the best method of controlling the swarming-fever? The free use of the extractor, or by making an artificial colony.
2. Is it an injury to bees to have more forage in the spring than they need for brood-rearing? Yes.
3. Is it necessary to give bees a flight that are wintered in cellar or house? No.
4. Should bees have ventilation in wintering; if so, how much? Yes; not as much as is generally given.
5. Side or top boxing, which is preferable? Two of the committee were in favor of top-boxes; one was in favor of both.
6. Which is the better method of swarming, natural or artificial, where box-honey is the object and you wish to double your stocks? Two of the committee prefer natural swarming; one prefers artificial.
7. Which is advisable to produce, box or extracted honey, when you have a ready market for either? Both.
8. Why do bees seal up cracks and openings in the hives? To retain the animal heat.
9. Should an excess of honey be removed from the hive in the fall or in the spring? In the fall.
10. How far apart should apiaries be located? From four to seven miles, depending upon the size of the apiary.
11. Is it important with the Italian bees that the guide-combs in the surplus-boxes extend from bottom to top of honey-boxes? The more comb the better.
12. Why do bees leave their hive about the 1st of May? Discouragement from confinement, mouldy combs, or small cluster of bees.
13. What is the best method of preventing after-swarms? Introduce a young fertile queen.
14. How should a queenless stock be managed when the keeper has no queen in the spring? Unite with another stock having a queen.
15. What should be done when in the case of an after-swarm whose queen had been destroyed, and which had been returned to the parent stock, but which persisted in coming out day after day? Destroy queens until all save one is gone.
16. Upon what conditions does success in wintering depend? Good stocks in the fall; proper temperature and ventilation; perfect quiet.
17. Is there any sure cure for foul brood save the destruction of bees and comb? Yes; by preventing brood-rearing, by the free use of the extractor, and by smoking the combs with brimstone.

RELATIONS BETWEEN POWER AND VELOCITY IN SCREW PROPELLERS.

By JOHN LOWE, of the U. S. Naval Engineers.

IT is something remarkable that, considering the numerous rules given to estimate the relations between the power and speed of steamships, there should be so very many examples afloat of disappointments and failures in these respects. It is even yet more remarkable that, of all these rules, no two give nearly the same results from the same premises. What wonder, therefore, if, in view of these facts, that perplexity and doubt should exist, and that a suspicion should arise that all were more or less faulty. Indeed, nearly all have a coefficient which reconciles the rule and the practice, and which coefficient may be taken either as a confession or as a concealment of the defects involved.

Take, for an example, the simplest rule of all:

$P = \frac{S^3 X}{B}$ W = Horse-power; S = Speed, and, B = coefficient, X; = Midship section.

Now B is found from known examples of vessels now or previously afloat—that is, we choose from our precedents a vessel having similar lines to our proposed vessel. But what if we have no precedent, as is very likely to be the case in a man-of-war, where traditional models must often necessarily be departed from. Suppose we desire a different type of engines, etc., and notably suppose we desire a better propeller than in the precedent.

Referring to our rule, we find that the coefficient, B, does not discriminate at all; but good and bad qualities of engine, propeller, and hull are lumped together in a mess, inextricable and misleading. Even under the best circumstances, our coefficient must be guessed at, and is it not easily seen that to guess at one quantity of a mathematical equation is as allowable as to guess at another, and so we might as well guess at the power as at the coefficient, and save an unnecessary calculation. So far, then, as this rule is concerned, it is not wonderful that engineers have been misled, and so many disappointments met with.

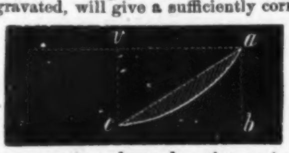
Mr. Froude's experiments conclusively settle the question regarding another rule, and we are only improved by knowing our errors, and therefore no longer trusting in delusions, though not positively knowing the correct method.

In the rule proposed by this paper, the direct issue is perhaps avoided, and the speed obtained indirectly; still it may not be without merit.

The power required to revolve a screw-propeller at a given rate, the vessel being fast to the dock, is the primary object sought for; because the writer has been enabled to verify his work with experiment. From this, by well-known rules found in Isherwood's works, the speed of the vessel may be found within a possible error of 5 per cent, this being the difference possible between our estimate of the slip and the slip actual.

A rule of this kind has the advantage of being able to tell us upon whom to fix the responsibility of failure, for if the propeller fails to revolve at a given rate at the dock, there would be no doubt as to whether it was the engineer or the constructor who was to blame.

It is to be distinctly understood, however, that this rule applies to propellers having a sufficient immersion; for, if the propeller throws off broken water from the surface, or if it displaces part water and part air, these conditions are difficult to estimate, and the power will vary with a lower function than the cube of the speed. In any case, however, the rule will give power enough, and, unless these noted exceptions are aggravated, will give a sufficiently correct result.



The figure represents a plane advancing against a fluid medium in the direction b to c, with the velocity v. It advances at an angle $\beta = acb$. The work done by this plane in displacing the fluid will be $dU = \frac{A\, v^2\, \delta\, dx\, \gamma}{2g}$

dU = work performed; A = a coefficient depending upon the angle β; δ = the width ab; v = velocity in feet per second; dx = the thickness of the plane; $2g = 64.4$ = effect of gravity; γ = the weight of one cubic foot of fluid, which we will pronounce to be salt water, and therefore $\gamma = 64.125$.

A, however, is a constant or rather coefficient depending upon the angle β at which the plane advances against the water. Although various authors give formulas for this coefficient, yet the writer obtained it for himself—that is, the trials at the dock of a number of U. S. naval vessels were taken as experiments.

The angles of the blades were laid off, and the power calculated for each angle, using each circular function, sine, versed sine, etc., and the results for each were plotted. Integration was then performed by means of the planimeter. This was repeated in a number of examples until the conclusion was arrived at that the sine was the correct function.

We have then $dU = \frac{\sin\beta\, v^2\, \delta\, dx\, \gamma}{2g}$ as a fundamental formula, or (1)

Our next step must be to so enlarge our formula that it may embrace all the planes situated in the radius of the screw-propeller. For this purpose,

Let n = number of blades.

x = radius of blade in feet.

R = revolutions of the screw in one minute.

Then $\frac{R}{60}$ = revolutions in one second.

$$v = \frac{Rx\, 2\pi}{60} \text{ and } v^2 = \frac{R^2\, x^2\, 8\pi^2}{60^2}$$

So that the work done by any plane situated x feet from the centre is

$$dU = \frac{\sin\beta\, R^2\, x^2\, dx\, 8\pi^2\, \delta\gamma\, n}{60^2 \times 2g} \quad (2)$$

Regarding P = pitch of the screw in feet, we have,

$$\sin\beta = \frac{P}{\sqrt{4\pi^2 x^2 + P^2}} = \frac{P}{2\pi\sqrt{x^2 + \frac{P^2}{4\pi^2}}}$$

For simplicity we will call this,

$$\sin\beta = \frac{P}{2\pi\sqrt{x^2 + a^2}} \text{ in which } a^2 = \frac{P^2}{4\pi}$$

Substituting and reducing in (2), we obtain,

$$dU = \left(\frac{x^3\, dx}{\sqrt{x^2 + a^2}}\right) \frac{P\, R^2\, 2\pi^2\, \delta\gamma\, n}{g \times 60^2}$$

This is the complete formula for a plane whose thickness is dx, and whose position in radius is x feet from the centre of the screw.

Since the total work done is the sum of all the small elements of work done by each plane in radius, we may call this formula the differential formula, and proceed to find their sum by integration. In order to make criticism easy, we will perform this operation by calling $z^2 = x^2 + a^2$.

$$\text{Then } x^2 = (z^2 - a^2);\ \frac{1}{z} = \frac{1}{\sqrt{a^2 + x^2}} \text{ and } z\, dz = x\, dx.$$

$$\text{Therefore} = \int \frac{x^3\, dx}{\sqrt{x^2 + a^2}} = \int (z^2 - a^2)\frac{1}{z}\, z\, dz.$$

$$= \int (z^2 - a^2)\, dz.$$

$$= \left(\frac{z^3}{3} - a^2 z\right) + C.$$

Restoring the value of z, we have,

$$\int \frac{x^3\, dx}{\sqrt{x^2 + a^2}} = \left[\frac{(a^2 + x^2)}{3} - a^2\right](\sqrt{a^2 + x^2}) + C.$$

$$= \left(\frac{x^2 - 2a^2}{3}\right)(\sqrt{a^2 + x^2}) + C.$$

Reducing x to o, we find that $C = \frac{2}{3}a^3$, and the complete formula for the screw is,

$$U = \left[\frac{(x^2 - 2a^2)}{3}(\sqrt{a^2 + x^2}) + \frac{2}{3}a^3\right]\frac{P\, 2\pi^2\, \delta\gamma\, n\, R^2}{g \times 60^2}.$$

In this, U is the work done in one second of time in foot-pounds. Sixty times this will be the work done in one minute, and this, divided by 33000, will give horse-power, which is the most usual mode of measurement.

$$\text{Therefore } W = \left[\frac{(x^2 - 2a^2)}{3}(\sqrt{a^2 + x^2}) + \frac{2}{3}a^3\right]\frac{P\, 2\pi^2\, \delta\gamma\, n\, R^2}{g \times 60^2 \times 33000}$$

This rule is not a simple one; but, in the light of numerous examples, is a correct one. Relying upon its merits, the writer respectfully invites criticism, and a reduction to a simpler form, which he thinks possible. Knowing now the power required at the wharf, it is easy to find the speed at sea, as before indicated.

A rule, giving the speed directly, is contemplated by the writer; but, until it is subjected to critical experiment, will not be presented.

[Engineer.]

HYDRAULIC RAMS.

THE following useful information is given by a correspondent of the *Engineer*: The efficiency of a ram need not be less than ·60 per cent., and not as illustrating the highest efficiency obtained. One that I erected at Churchfield House, West Bromwich, gives off an efficiency of ·84 per cent. I must acknowledge that I have not yet been able to reach ·90 per cent. These are the proportions asked for by Mr. Hett:

(1) Fall, 18in.; supply, 19 quarts per minute; height of delivery, 20ft.; quantity raised, 1 quart per minute; length of injection pipe, 13ft. 6in.; diameter of pipe, 1½in. at leading end and 1¼in. at junction with ram; diameter of pulse valve, 2¼in.; number of beats per minute, 68; efficiency of ram, ·70 per cent. (2) Fall, 50ft.; supply, 16 quarts per minute; height of delivery, 153ft.; quantity raised, 5 quarts per minute; length of injection pipe, 300ft., and 2in. diameter at leading end and ¾in. diameter at junction with ram; diameter of pulse valve, 2in.; number of beats per minute, 120; efficiency of ram, ·76 per cent. I believe I am the only maker of hydraulic rams that uses a taper injection pipe, but its advantages must be obvious to any one who will give a moment's thought thereto.

"R. E. D." has asked for, but not obtained, the proportions of a ram that will in his case yield an efficiency of ·60 or ·70 per cent. I herewith give him the particulars required. Height of fall being 9ft.; supply, 28 gallons per minute; height to be raised, 35ft.; and length of rising main, 250ft. Length of injection pipe should be 54ft.; diameter at leading end, 4in.; at junction with ram, 2½ in.; diameter of pulse valve, 4½in.; number of beats, about 75 or 80 per minute; diameter of rising main, 1½in. With a ram otherwise well proportioned, an efficiency of at least ·72 per cent may be relied upon, or a yield of 21 quarts per minute. I will guarantee 20 quarts.

If I have not already trespassed too much upon your valuable space, perhaps you will allow me to give the rule I adopted some years back for determining the proper size of a ram and the injection pipe, the quantity of water available as supply, and the fall being given; I may say in passing it is the result of a great number of experiments, and of close observation, and I have never known a ram yield less than ·60 per cent. since adopting it. Injection pipe at its junction with ram should be of the same diameter as a pipe which, being one yard long and having a head of six inches, will pass three times the quantity of water that is available as supply, because the water in an injection pipe only flows towards the ram about one-third of its time. Now, supposing we had a supply of 10 gallons per minute, a pipe one yard long, that will pass thirty gallons per minute with six inches of head, will require to be 1½in. diameter, which is the size required. Having got the diameter of the small end, what size should the leading end be? Again, supposing we had a fall of 10ft., a 1½in. pipe, one yard long with 10ft. of head, will pass 134 gallons per minute, and it will require a pipe 2¾in. diameter, one yard long with 6in. of head, to pass 134 gallons per minute; the large end should thus be 2¾in. diameter, and taper down to 1½in. at ram to be of equal carrying capacity throughout its whole length. Length should be 9ft. long for each foot of fall, for 2ft. and under; 8ft. long for each foot of fall, for 3ft. and under; 7ft. for each foot, for 4ft. and under; and 6ft. for each foot of fall, for 5ft. and upwards, with taper injection pipes. Area of pulse valve should be equal to four times the area of injection pipe, at its junction with ram, thus: Area of 1½in. injection pipe being 1·7671, which, multiplied by four, gives 7·0684 as the area of valve, or 3in. diameter. No double valves are required where these proportions are used; the valve being of so large an area, its stroke never exceeds five-sixteenths, which entirely does away with the usual long sledge-hammer stroke that destroys the valve. Rising main should be of such a size that it will not add more pressure on the ram that is due to a head of 2ft. or 3ft. Of course the longer it is the larger it should be; a 1in. pipe 200 yards long will convey 2 gallons per minute with a little more than 2ft. 3in. of head; if it is 600 yards long, it will require a head of nearly 10ft. to pass the same quantity.

STAFFORD, ENG., Feb. 1876. B. MASSEY.

[American Journal of Science and Arts.]

NEW TERTIARY LAKE BASIN.

By GEORGE B. GRINNELL and EDWARD S. DANA.

SEVERAL Lake Basins of Tertiary age have already been discovered in the Rocky Mountain region, and the more important of them have been carefully explored. Those of Eocene age have only been known since 1870, but the Miocene deposits of the White River have long been noted for their wonderful scenery, as well as for the number and variety of the mammalian remains found in them. Another Miocene basin is known in Oregon, and both the lake beds of this period are overlaid by deposits of Pliocene age.

During the explorations carried on last summer under the direction of Col. William Ludlow, Corps of Engineers, a series of Tertiary deposits were identified by the writers near Camp Baker, Montana. These deposits indicate the existence in this region of a Miocene lake basin, which was succeeded by another lake basin in Pliocene time. As these basins are quite distinct from those heretofore known, it is considered important to put the fact of their discovery on record.

Camp Baker is situated on Deep Creek, a stream which flows into the Missouri River above Sun River. It lies about fifty miles nearly due east of Helena. It is surrounded on all sides by mountains, of which the Big Belt Range, lying immediately to the south or southwest, is the highest and most conspicuous. The Little Belt Mountains lie to the North, and the Crazy Woman Mountains to the southeast, though at a greater distance.

The Tertiary beds found here consist for the most part of homogeneous cream-colored clays, so hard as to be with difficulty cut with a knife. The beds are horizontal, and rest unconformably upon the upturned yellow and red slates below. The clays of which they are formed resemble closely those found in the Miocene beds at Scott's Bluffs, near the North Platte River, in Wyoming. The deposits at Camp Baker have been extensively denuded, and nowhere reach any very great thickness. At a point about three miles southeast of the Post, some bluffs were noticed where the Miocene beds attained a thickness of 200 feet, and these were capped by fifty feet of Pliocene clays, both beds containing characteristic fossils. In the underlying Miocene beds were found a species of *Rhinoceros*, several species of *Oreodon* Leidy and *Eporeodon* Marsh, a canine tooth apparently of *Elotherium* Pomel, and remains of Turtles. In the Pliocene beds the principal fossils were a species apparently of *Merychyus* Leidy, remains of an equine smaller than the modern horse, and Pliocene Turtles. These fossils have not yet been carefully studied, and for this reason their relations to the remains found in the other lake basins of similar age can not here be stated.

We saw the first exposures of these beds a few miles west of the Sulphur Springs, just after crossing a rather high ridge of trachyte through which Deep Creek flows in a narrow and picturesque cañon. This point is about six miles southeast of Camp Baker. From here the lake bed was traced continuously long Deep Creek for a distance of fifteen miles, extending quite up to the mountains on the eastern side at least. Beds of the same character containing similar fossils were found on White-Tailed Deer Creek, a branch of Deep Creek, about seven miles to the north of Camp Baker, as well as on Camas Creek to the southwest of the Post. Traces of this deposit, containing what appear to be remains of *Rhinoceros*, were also found two miles or more south of Moss Agate Springs, and at a considerable elevation above the creek-bed. With more time than we had at command they could no doubt have been traced much farther, although in many places the beds have been washed out, or have been covered by the later local drift.

These Tertiary beds were all laid down after the elevation of the mountains and the igneous eruptions. They are, as has been said, perfectly horizontal, and are often seen covering over ridges of trachyte. The line of separation between the Miocene and Pliocene beds is in some places well marked. It consists of about six feet of hard sands, interstratified with layers of very small water-worn pebbles soldered together into a hard mass, but easily picked out with a knife. Each of these layers is about six inches in thickness. Immediately above these strata the Pliocene fossils were found. In several places fragments of trachyte were noticed in the Pliocene beds.

Near Camp Baker are a series of upturned ridges of Potsdam sandstones and limestones at a level very little above that of the Tertiary beds, and doubtless in this region the lake was divided into many arms, which bent around and extended among these ridges.

It is known that in the neighborhood of Fort Shaw, and near Helena, Pliocene deposits exist, and at Fort Ellis and in the valley of the Yellowstone we saw, but were unable to examine, gray sands and marls, which Dr. Hayden refers to the same age.

No Miocene beds, however, have been identified at any of these localities. It seems probable that in Pliocene time at least, the Baker Lake may have extended north to the Missouri River, and perhaps up that stream to the Three Forks, thus connecting with the lake which existed near Fort Ellis. Indeed, it would seem that we just touched upon the southern edge of this basin, which may have extended far to the north and west.

An interesting point in connection with these deposits is the fact that they are at a much greater elevation than any other beds of the same age now known on the continent. The elevation of the White River and Colorado beds is about 3000 feet, and that of the Oregon basin somewhat less, while that of the deposits near Camp Baker is over 5000 feet.

In reference to the relations which this lake basin bears to the Oregon basin and to the White River deposits, nothing can be certainly known without a careful exploration of the whole region and a thorough study of its vertebrate remains. It is by no means impossible that the Baker Lake may have flowed into that at White River by some old river channel, but so little is known of the intervening country that no definite opinion can be pronounced on the subject.

THE COMBER ENGINE NOT NEW.

To THE EDITOR OF THE SCIENTIFIC AMERICAN:

In number 11, page 165, of the SCIENTIFIC AMERICAN SUPPLEMENT, there is an illustration of a novel steam-engine invented by Mr. W. A. Comber, of Birmingham, England. The fact may have escaped your notice that the same thing in principle was invented twenty-five years ago by Mr. S. Furman, of Romulus, Seneca County, N. Y., and illustrated in the SCIENTIFIC AMERICAN in the year 1851, volume 6, page 361.

GEORGE STRINGER

ITHACA, N. Y.

IMPROVEMENT IN GRAIN-DRIERS.

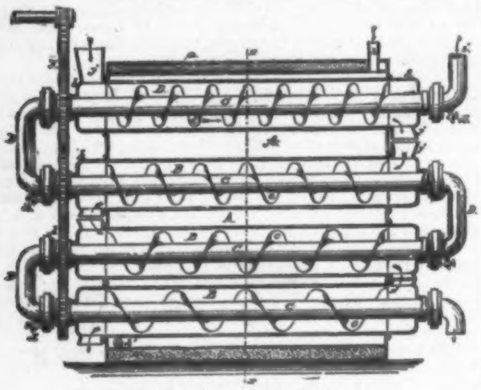
By C. B. STACY, Richmond, Va.

CONSISTS in an apparatus whereby the material to be dried, as it passes through two or more successive cylinders, is carried a longat a higher rate of speed than that at which it passed through the first cylinder.

A represents a steam-chest, provided at the top with a pipe, *h*, for admission of steam into the chest, and with a pipe, *h'*, at the bottom for drawing condensed steam from the same.

A series of cylinders, B, pass longitudinally through the chest A.

A hollow revolving shaft, C, passes through each cylinder,



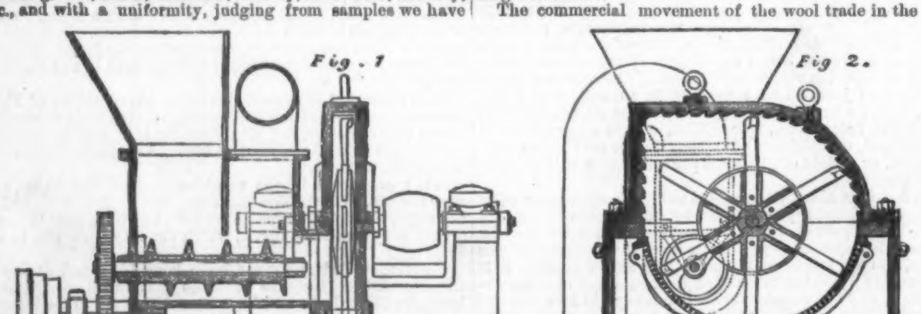
IMPROVED GRAIN-DRIER.

B, and on its circumference is a spiral flight or conveyer, *c*. Steam, admitted at *i*, passes through the hollow shaft C.

The shafts are caused to revolve by power applied to the gear-wheels, and the material to be dried introduced into the top cylinder B through hopper *j*, and as it is carried through the said cylinder by the flight or conveyer *c* it is subjected to heat from the steam in chest A, and also, at the same time, to heat within from the steam passing through the hollow shaft C in a direction opposite to the advancement of the grain or other material being dried, and so the same process continues through the series of cylinders. When the material being dried reaches the end of the first cylinder it falls through spout *j* into the next lower cylinder, and is carried to the far end of that cylinder at a higher rate of speed than that at which it was carried through the first cylinder, and so the operation is continued until the grain is passed through as many cylinders as it is found necessary to employ for drying the material.

IMPROVED DISINTEGRATOR.

WE illustrate a new disintegrator recently introduced by Messrs. Carter Brothers, London, England, which possesses several special features and improvements rendering it worthy of notice. With disintegrators in general, the great difficulty has been to obtain a uniform product of ground material, the difficulty arising from the construction of the gratings or screens through which the pulverized or granulated material has to escape. These have been placed at the sides of the machine, have been made louvred or valved, and have been in various ways protected from the direct action of the beaters or arms which effect the pulverization. A distinctive feature in Carter's disintegrator is that the openings of the screens or gratings through which the material has to escape are exposed to the direct action of the beaters, and are thus much less likely to choke up with damp or sticky materials than holes protected or placed at the sides. Substances of widely different character are reduced to any required degree of powder, granulation, or shredding, as, for instance, coal, oak-bark, grain of all kinds, dye-woods, furze or gorse, foundry blacking, ores, bones, manures, chicory, seed-cakes, fire-clay, etc., and with a uniformity, judging from samples we have



IMPROVED DISINTEGRATOR.

seen, that leaves nothing to be desired, and that, too, without any sifting or dressing whatever.

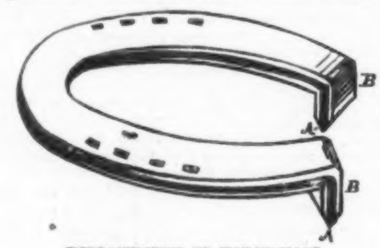
Fig. 1 is a longitudinal section, and Fig. 2 a cross section through the feed chamber of the machine. The material to be operated upon is fed from a hopper into a trough containing a worm which carries it forward into the disintegrator, where it is caught by the extremity of the arms or beaters and thrown violently into the recessed and corrugated pocket. From thence it returns again and again to the action of the beaters until fine enough to pass away through the screens which form the whole bottom semiperiphery of the machine, the corrugations in the top retarding the material from being carried round, and also assisting in disintegrating it. For many purposes the screw-feed is not necessary, an ordinary adjustable feed-shoe and hopper being all that is required.

For materials that require to be made impalpably fine, a modification of the machine is used, in which the open gratings are replaced by corrugated pieces similar to those in the upper part, and part of the top opened up and furnished with a trunk, having several baffle-pieces fitted in it, and leading into a large receiving chamber. The material when fed into the disintegrator can only escape by being carried upwards into the receiving chamber by the current of air caused by the beaters. The material settles in the chamber, and a return air-pipe from the latter back into the feed, trough relieves any pressure of air and prevents any escape of dust. For foundry use these machines seem to be especially suitable, as they will grind coal, loam, sand, etc., and they also possess advantages over millstones, no stoppage for dressing being required. The beaters, which are the only parts subject to wear, can be repaired by any smith, while the alteration of the screens can be effected in five minutes. The machines are self-contained, and can be placed on any ordinary floor.—*Engineering.*

IMPROVEMENT IN HORSESHOES.

By T. THISTLEWOOD, Sparta, Wis.

A BAR of steel is placed between two bars of iron, and all are rolled together at welding-heat so as to form a single bar having an iron surface above and below, and a steel centre running the whole length of the new or compound bar thus made. This compound bar is rolled to the proper size for making horseshoes, or what is known in the trade as horse-



IMPROVEMENT IN HORSESHOES.

shoe-iron. Then the horseshoes are made in the usual way from this compound bar of metal, having a steel centre. When the shoe is completed, the points of the calks consist of steel, as seen at A, Fig. 1. These calks are self-sharpening, because the softer iron at the sides of the calks wears away by use faster than the harder steel centre, or point of the calk; also, the nail-holes and the shoe itself are stronger and less liable to wear or break on account of the greater strength and hardness of the steel. In cutting old shoes thus made to fit a smaller foot, the steel will always form the point of the new calk, which will be self-sharpening.

[Journal of the Royal Agricultural Society.]

WOOL.

THE Austrian official reports of the Vienna Exhibition of 1873 remind us that England is the first manufacturing State of Europe; and her manufactures of woollen goods are so important, that the mighty Island Empire is at the apex of this industry also. The wool growth of Europe is now superseded by the abundance of Australia, the Cape, and La Plata. A characteristic of wool is its transportability; on an average, its price is twenty or twenty-five times as high as that of corn, hence trans-oceanic competition is easy, and the wool trade is an essential part of the commerce of the world. It is calculated that England now annually consumes more than one fleece for every inhabitant: the consumption of wool is steadily increasing, and already quantities of so-called artificial wool are brought into use; clean fleeces being required to work up this unstable shoddy.

The general consumption of wool in England is said to be 4½ lbs. per head of the population—some 3 lbs. per head in Germany. In Europe, there is no country but Russia which is capable of greatly developing in respect to quality and quantity the production of wool: London is the central market for the wool trade: auctions are held were buyers congregate from all parts of the world. England being the largest consumer of wool, the fluctuations of the European wool trade have from olden times depended on those of the English market.

The commercial movement of the wool trade in the leading states of Europe and the United States of North America for the year 1870, is exhibited in the following table:

England imports 238,820,852 lbs.; exports 94,911,916 lbs.
France imports 167,422,200 lbs.; exports 25,711,412 lbs.
Belgium imports 147,092,128 lbs.; exports 66,543,920 lbs.
Germany imports 90,000,000 lbs.; exports 25,000,000 lbs.
Austria imports 21,680,900 lbs.; exports 16,392,700 lbs.
Netherlands imports 16,991,972 lbs.; exports 13,906,260 lbs.
Russia imports 2,648,700 lbs.; exports 28,558,577 lbs. North-America imports 62,202,714 lbs.; exports 12,067,689 lbs.

As to the consumption of the most important European States, England, engaged in progressive development, and France stand at the head of the wool manufacture. In the year 1870–71, England manufactured 330,000,000, and France 300,000,000 pounds of wool of all descriptions.

CURIOUS COPYRIGHT CASE.

MISS THOMPSON sold her now renowned picture of *The Roll-Call* for the ridiculous pittance of 100*l*. paid beforehand; and, after its repute (partly genuine and partly factitious) had been established, she thought, by disposing of the copyright for 1200*l*., to indemnify herself for her previous want of good fortune. But it turns out that she had no legal power to dispose of the copyright; in parting with the picture, without expressly reserving the copyright, she parted with the latter also, which, according to law, vested in the purchaser, Mr. Galloway. He meanwhile had resold the picture, for the like amount of 100*l*., to Queen Victoria. Who now owns the copyright? Miss Thompson, who never consciously sold it, being excluded, is the owner the Queen, who never bought it, or Mr. Galloway, who never stipulated for buying it? Sergeant Parry believes Mr. Galloway still owns the copyright, for he became its possessor by force of law, and never definitely sold it afterwards. This point remains undetermined. What is determined is, that Miss Thompson, who had not dreamed of selling the copyright, has lost it, and Mr. Galloway, who had, probably, not known himself to be the purchaser, had acquired it. And *he*, it is suggested, was protected by law in retaining it, because he did not expressly transfer it to the Queen, although Miss Thompson was not similarly protected when she also did not expressly transfer (nor yet expressly reserve) it.—*Academy.*

SUPPORTER FOR COTTON-PICKERS.

By W. J. LYNCH, Old Town, Ark.

DESIGNED to be worn by cotton-pickers while at work; and consists of two wooden staffs, having peculiarly constructed foot-rests pivoted at the bottom, and sliding connections near the centre of the same, adapted to act in connec-

FIG. 1.—SUPPORTER FOR COTTON-PICKER.

tion with a waist-belt and shoulder-straps worn by the operator.

The belt A is adjusted around the waist of the cotton-picker, the bands E passing over the shoulders, and the feet fitted into the foot-rests C, the bottoms of the staffs resting upon the ground, so as to bring the bottoms of the feet on a level with its surface. As the wearer passes from one stalk of cotton to another in the different stooping positions taken

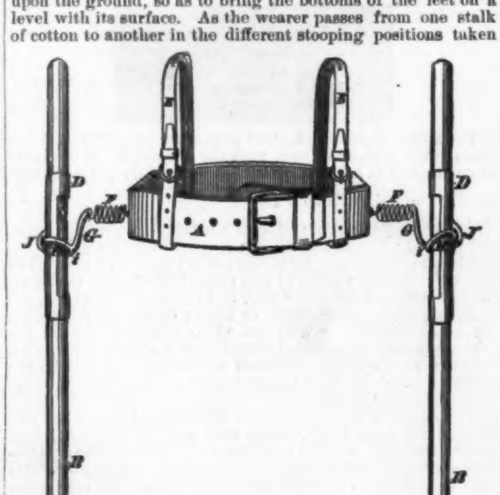


FIG. 2.—SUPPORTER FOR COTTON-PICKER.

while picking, he is supported at any point by throwing the knees outward against the staffs, which action presses the lug *i* into the staff, and holds the operator in a comfortable and easy position, and when he rises to a higher position the action throws the lug *i* off from the staff to admit of the sliding cylinder moving higher to the position desired.

NEW NICKEL MINERALS.

Garnierite and *Nouméite* are two new nickel minerals found near the town of Noumea, in New-Caledonia, and described by Prof. Liversidge, of Sydney. They are very similar to each other in appearance, though they are considered to have some distinguishing characters. They are amorphous, of a bright apple-green color, and so soft as to be easily polished by rubbing with the thumb-nail. The economic importance of these minerals lies in the fact that they contain about 25 per cent of nickel-oxide, which, as they occur in large quantities, makes them valuable as nickel ores. They both occur filling veins and fissures in serpentine.